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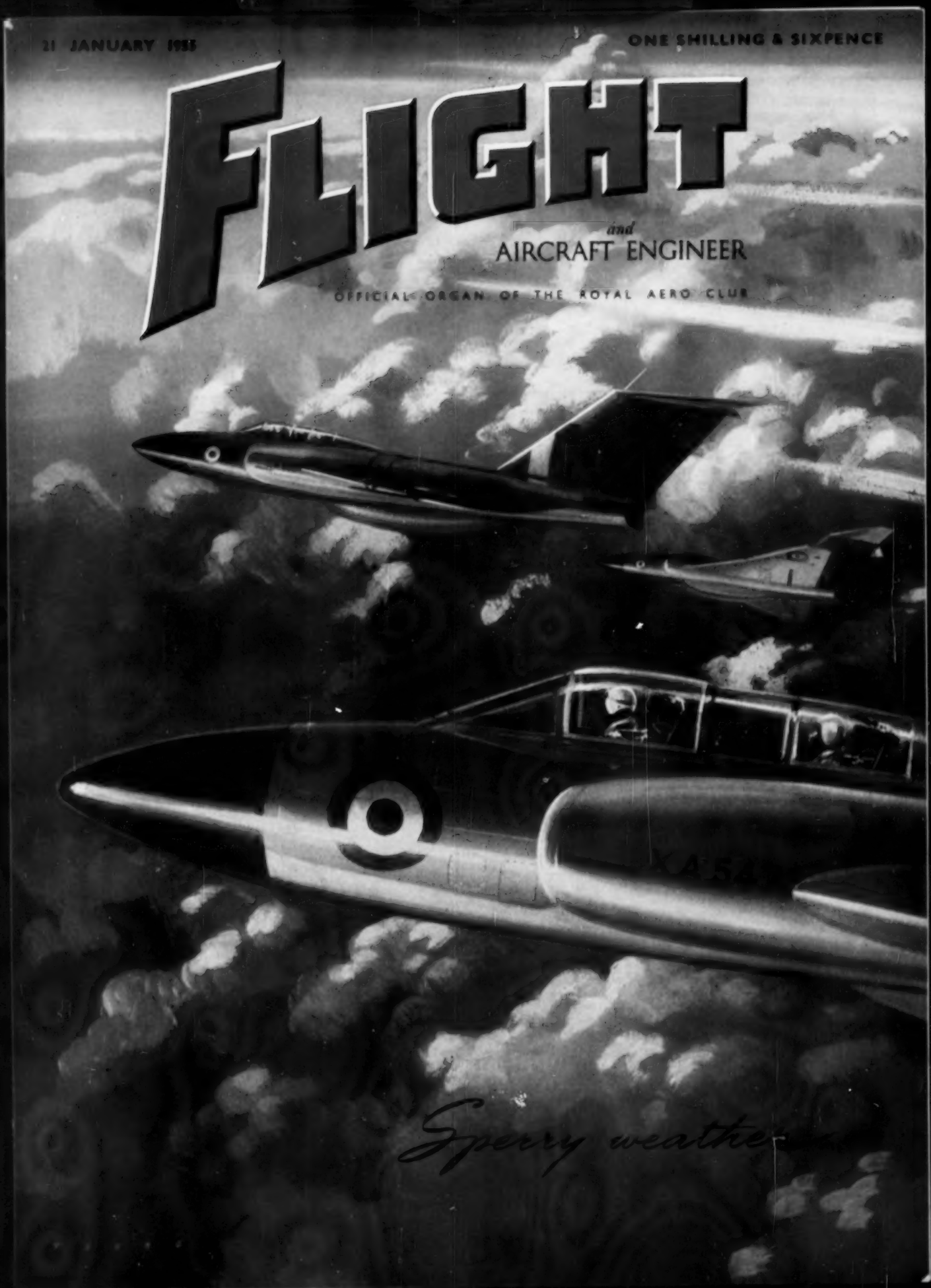

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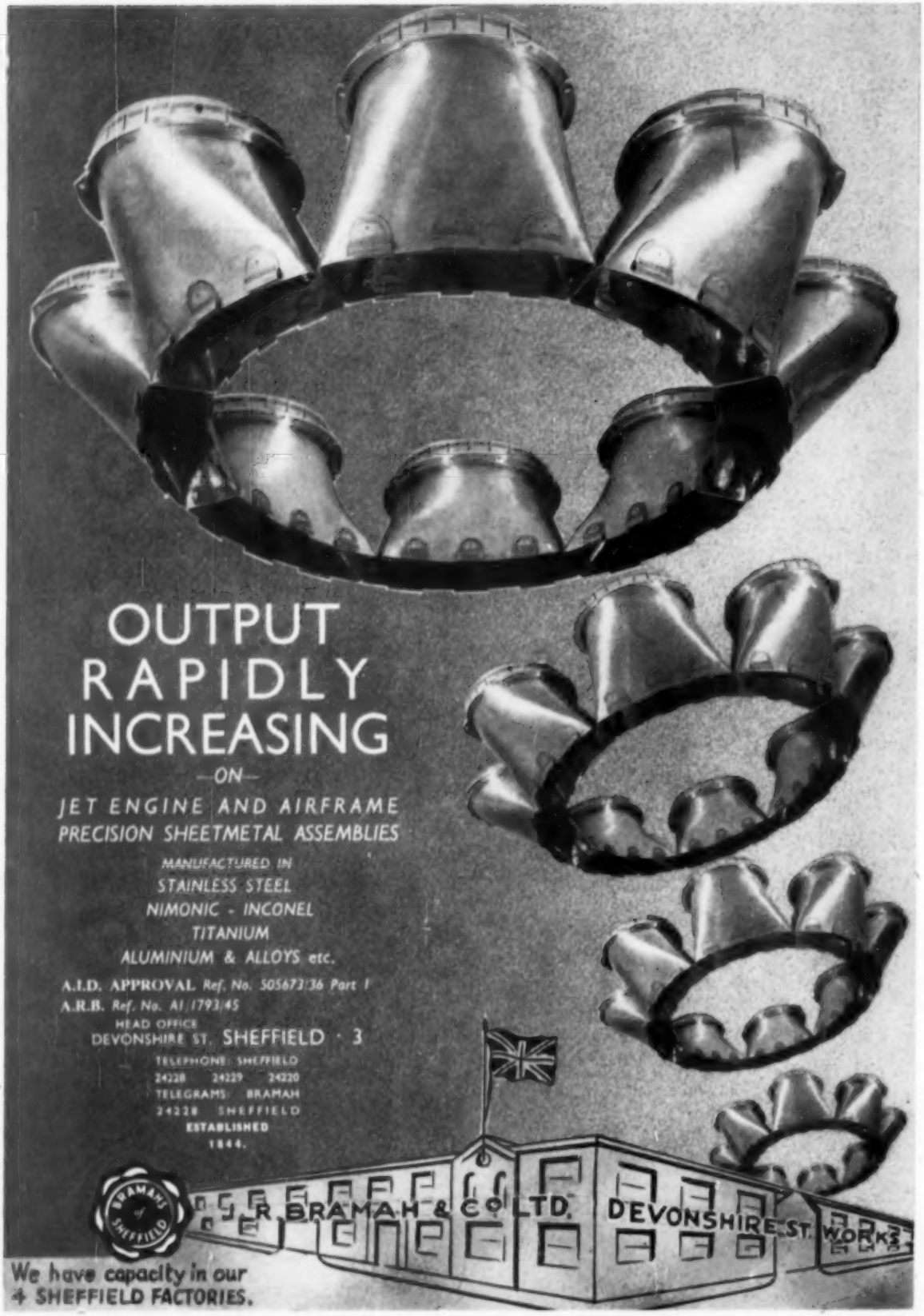
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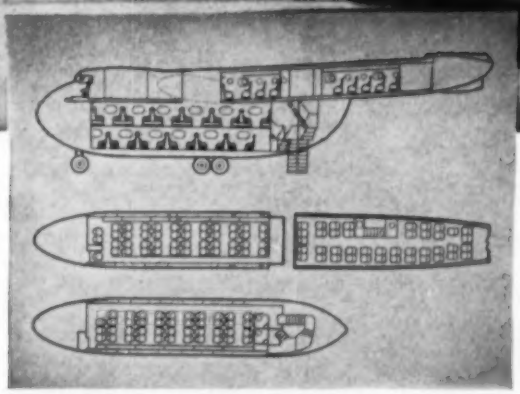

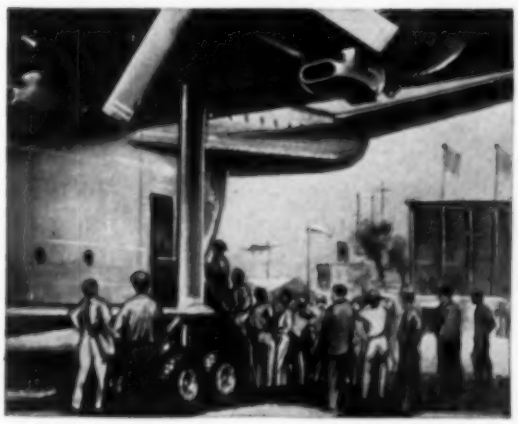

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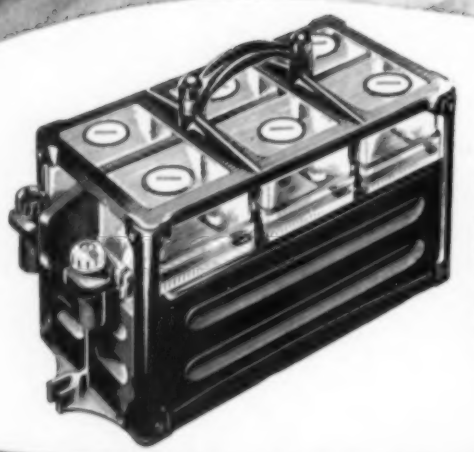

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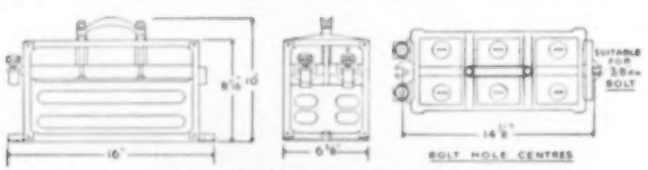

Side and end views of 6-EP19B/2 with battery layout diagram

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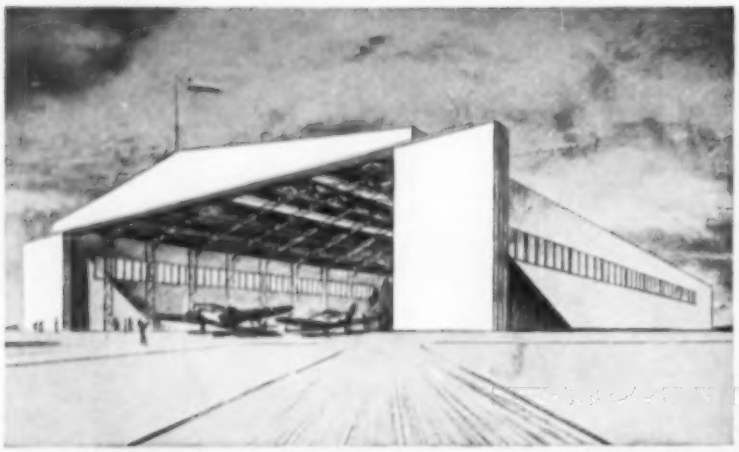

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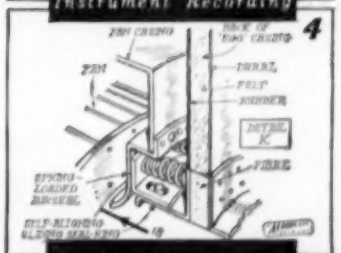

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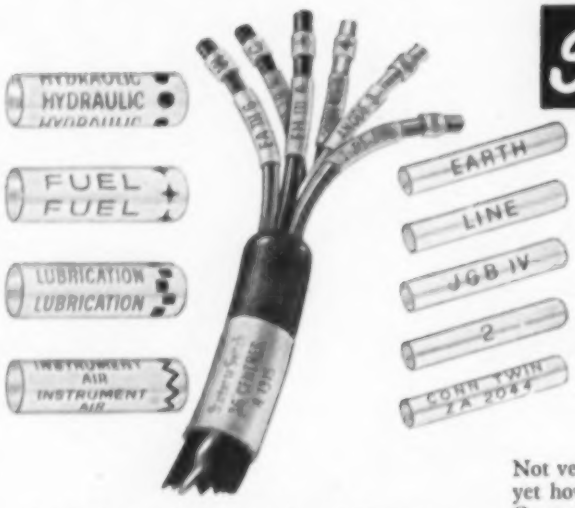

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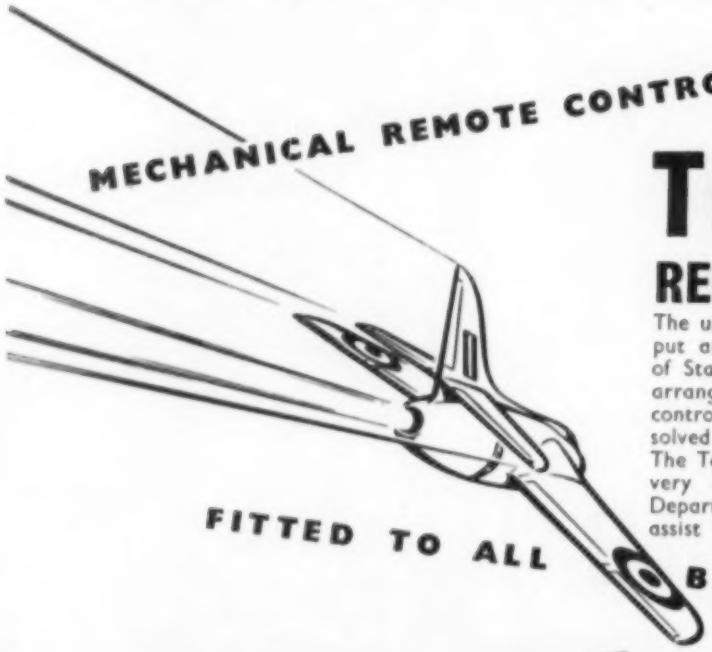

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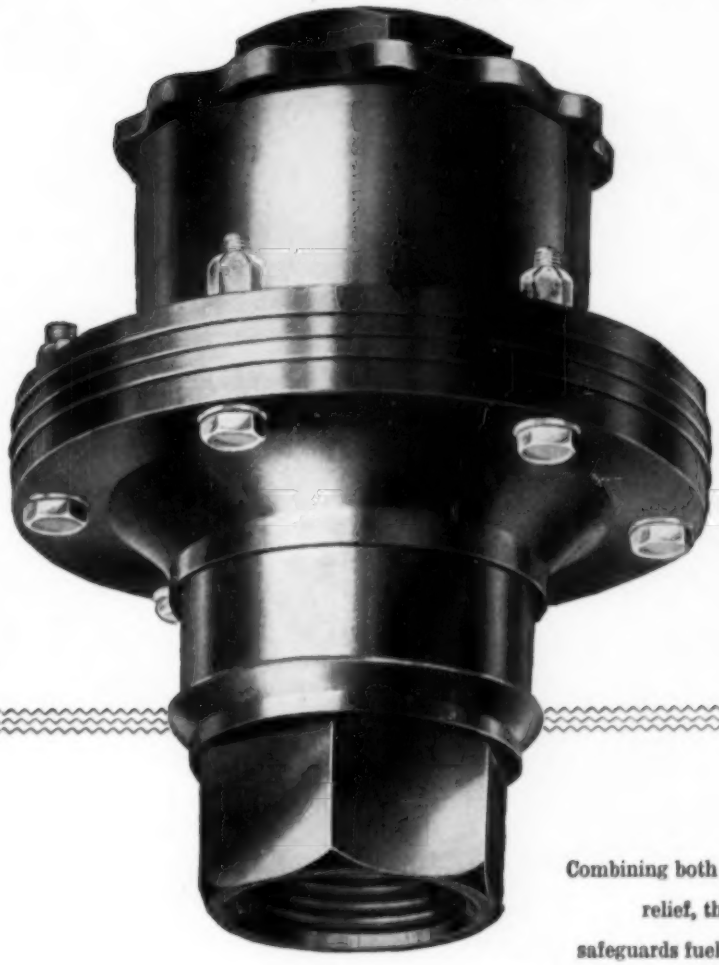

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On the Slab

ONE of our 1955 resolutions was to tidy our thoughts in the matter of the all-moving tail, and in the process of implementing it we discovered (as we might have known) that today's supersonic panacea was old stuff around 1910. For sweet simplicity's sake it was occasionally resurrected in later years, notably on the D.H.77 intercepter monoplane of 1929—a "believe-it-or-not," this, which has special point in the present issue, wherein a very remarkable descendant of the "77" is the subject of felicitous news, partly by reason (it may be supposed) of its "slab" tail. And having marshalled our clear and righteous thoughts on a formerly perplexing topic, we now offer them as a plain man's guide.

Three forms of horizontal tail surface—"v.i." (variable incidence), "all-flying" and "slab"—are now being generally applied to transonic and supersonic aircraft. They were rendered necessary by the formation of shock-waves at high speeds and by flow-separation downstream of these waves, which, in many instances, rendered both the trim tab and the elevator itself ineffective.

Between the wars, of course, the variable-incidence tail had been commonly used as a trimming device on fast aircraft but was more or less abandoned as speeds increased—out of considerations of strength! It was reinstituted, on the North American F-86A Sabre, to develop the exceptional transonic potentialities of that fighter. In the modern "v.i." application fore-and-aft trim is achieved by an irreversible electric screw-jack controlled by a switch in the cockpit (most conveniently, on top of the control column). As well as maintaining trim the device can be used in manœuvring, to lighten stick forces produced by the elevator. It is employed in conjunction with direct-mechanical, or power-assisted, elevators.

For even more effective control it became evident that the *whole* of the tailplane and elevator surface should be operated from the control column, through a fully powered irreversible transmission—hence the "all-flying" tail. This system, first applied to the F-86E, is so arranged that the tailplane is moved directly from the stick while the elevator is entrained by it as a "follow-up" surface, through a differential linkage. The entire surface is thus cambered in the direction of the desired control response. Trim is achieved by offsetting the relative incidence, in the neutral position, of elevator and tailplane.

All of a Piece

The latest configuration—the "slab"—has been almost universally taken up for American high-speed fighters and, for the first time in Britain, for the D.H.110. With the slab system the whole horizontal tail is one pivoted rigid structure, moved from the control column through an irreversible fully powered transmission, with the stick-top trim-switch usually acting on the "artificial feel" gear or stick-centering mechanism. The slab tail is now considered well-nigh indispensable for adequate control in transonic and supersonic flight, especially when fore-and-aft instability, or "pitch-up" (an affliction suffered by some conventional types of swept-wing fighter) is likely. Any kind of aerodynamic tab is rendered quite ineffective once shock-waves build up at, and beyond, about Mach 0.85.

The slab, then, bids fair to remain as long as aerodynamic design proceeds along present lines. First exploited, in its modern "high-speed" application, by America, it has been taken up by a British company (as often in the past) with heartening results, for we believe that when performance figures of the D.H.110 are at last disclosed this big all-weather two-seater will prove to be well in advance of many single-seat day intercepters of more or less contemporary design. Certainly we may suppose that Mach numbers well over its publicly demonstrated unity have by now been achieved in shallow dives; and the possibility exists that, with advanced "five-figure" versions of the Rolls-Royce Avon, the Navy's ultimate version of their Sea Venom replacement might prove supersonic in level flight.

Meanwhile, it is not unreasonable to suppose that the slab tailplane might be applied with similarly happy results to other existing British fighters.

FOR SERVICES TO THE COMMUNITY: Mr. George Dowty receives the honorary freedom of the Borough from the Mayor of Cheltenham, as recorded on this page. The Town Clerk, Mr. F. D. Littlewood, holds the casket.

FROM ALL QUARTERS

Minister at Derby

IN the course of a speech at a civic luncheon given by the Mayor of Derby, Alderman Ling, in the Council House, Derby, on January 12th, the Minister of Supply, Mr. Selwyn Lloyd, said that the primary purpose of his visit to Derby had been to see something of what the Rolls-Royce company was doing. On the subject of military aircraft he said, "It may be comparatively not so difficult to construct a flying machine which will travel at one-and-a-half times or twice the speed of sound. It is quite another thing to turn that flying machine into a weapons system, that is to say, to equip it with adequate armament, and means of control so that at that speed and at the appropriate altitude it is an effective fighting weapon."

Speaking at the Rolls-Royce works on the subject of our first-line jet fighters, the Minister said, "The problems concerned development rather than production. The R.A.F. is being re-equipped with Hunters and substantial numbers of these aircraft have been delivered. It is, I think, fair to state that the Swift, although a very fine aircraft, has not yet reached the same stage of development. There are certain problems but these are being, and will be, overcome."

Mr. Selwyn Lloyd discussed with senior executives the Avon-powered V.T.O. aircraft being constructed by the Ryan Aeronautical Company, of San Diego, and he was shown an Avon undergoing tests in a vertical position.

Death of James Verdin

AFTER California's Mojave Desert had been scoured by more than 2,000 searchers and 25 aircraft, the body of Lt-Cdr. James Verdin, U.S. Navy, who last year established a world air speed record of 752.944 m.p.h. in a Douglas Skyray, was discovered with unopened parachute, three miles from the wreckage of the Douglas A4D Skyhawk which Verdin had been testing. He had baled out at 30,000ft.

"Zero-Length" Fighter Launching

DISCUSSIONS of vertical take-off fighters often overlook the possibility of launching standard machines in "zero" distance from a suitable structure with the aid of rockets. It is now officially announced that this technique has been developed by the Air Research and Development Command of the U.S.A.F. and the Glenn L. Martin Company of Baltimore.

To "explore the possibility of eliminating runways under certain combat conditions" Martins have been using platforms mounted on trucks, i.e., the technique employed for the Matador "pilotless bomber." The aircraft involved were Republic F-84G Thunderjets with Matador-type booster rockets attached beneath the tail. According to Martin test pilot Bob Turner, the shock of the take-off is less than is experienced during a normal catapulting, peak acceleration being 4 g.

The launching system has been proved in nearly 200 Matador launches by the A.R.D.C., the Tactical Air Command and Martin engineers during the past few years. Though the Thunderjet is considerably larger and heavier than the Matador, it has served to demonstrate that the same launching technique is applicable to fighters.

A U.S.A.F. spokesman has referred to the mobility of the launchers and envisages jet fighters operating close to the front lines while presenting minimum targets for bombing. It is foreseen that normal landings would be made at forward bases and the aircraft immediately dispersed for maximum protection. The U.S.A.F. consider this to be especially important in the age of atomic weapons, when a single bomb might wipe out a conventional airfield and render its entire area indefinitely untenable.

Mr. George Dowty Honoured

IN the presence of the Mayor and Mayoress of Gloucester, Councillor and Mrs. Howard Gibson, the Mayor and Mayoress of Tewkesbury, Alderman and Mrs. T. G. Bannister, the Speaker of the House of Commons, Mr. W. S. Morrison, M.P. for the Cirencester and Tewkesbury division, and other dignitaries, Mr.

OFF IN A FLASH: Filled with eerie drama is this photograph of a Republic Thunderjet leaving the Martin Matador - type zero launcher, subject of an item on this page.

***CAPITAL PROGRESS:** Delivery of Capital Airlines' 60 Viscounts will begin in the spring with an initial batch of three aircraft, the first of which is seen under construction at Hurn.*

George H. Dowty, chairman of the Dowty Group, last week received the honorary freedom of the Borough of Cheltenham from the Mayor, Councillor A. W. Mann.

This unusual honour was conferred "in recognition of the distinguished and eminent services rendered by him in the field of industry and to the progress and life of the town over many years, and in token of the esteem and affection in which he is held."

Alderman D. L. Lipson, a fellow freeman, proposing Mr. Dowty, pointed out that it would be the first occasion on which the Borough would be conferring its freedom on an industrialist. This was evidence of the change which had taken place in Cheltenham in recent years. The town had become a very important centre of industry, and the man who was very largely responsible for that was Mr. Dowty.

"Trawl" Rescues by Helicopter

THOUGH helicopter rescues from the sea and from floods are now quite frequent occurrences—more were reported last week—the process is not always without its difficulties. The normal method of rescue is by lowering a strop from the helicopter winch; the person in the water then fastens it round his waist, or an aircrewman is lowered to assist him. These measures often prove tricky, and there is the added risk that the injured person may be further injured when his weight is taken by the strop.

In an endeavour to overcome some of these disadvantages the Search and Rescue Unit at R.N. Air Station Ford, Sussex, has designed the "scoop net" seen in the accompanying photographs. It is of simple but ingenious design. Having a frame shaped rather like the letter D, but with the straight side open, it is lowered into the water and towed at about 5 kt towards the casualty, a small drogue keeping the open side of the net forward. If all goes well—and it has done so in the course of 100 "live" pick-ups—the casualty is scooped into the net and can then be comfortably hoisted through the 25 feet or so to the helicopter, either to climb aboard or to be lifted in, according to his condition.

It is not intended that the new method shall replace those already in use, but it is regarded as a very useful addition to air/sea rescue technique and is being made available for general Service use and supplied to carriers and Naval air stations.

The inventor of the net is the commanding officer of the A.S.R. Unit at Ford, Lt-Cdr. J. S. Sproule, R.N., and the trials have been carried out by him in conjunction with other members of the unit, including Lt. J. Walden, R.N., second pilot; C.P.O. Aircrewman S. Lock; and L/Tel. R. J. Tomkins.

Aerial Warfare in South America

ENGAGEMENTS in the armed uprising in Costa Rica have been distinguished by a use of air-power which, having regard to the meagre resources involved, is considerable. The rebels initially claimed complete air superiority and made effective tactical use of their two Harvards and a Thunderbolt. The only opposition which the Costa Rican Government could at first bring to bear was from a Dakota commandeered from the local airline, Lacsa, and hastily converted to carry two 0.30in machine guns firing through the open doors. The co-pilot carried a .45in automatic. A dog-fight actually occurred when the Dakota attempted to intercept the Thunderbolt but, though all weapons were fired, no decision was apparently reached.

The balance of aerial power was, however, completely reversed when four Mustangs (bought for the nominal sum of $1 each) and spares were delivered from the U.S.A. to the Government forces. Costa Rican pilots were "shown over" the cockpits and went straight into action—whereupon all three aircraft of the rebel air forces lost heart and landed at Rivas Airport, Nicaragua, and were formally interned. Reports suggest that proper tactical use of only three rebel aircraft had had a major effect on the ground fighting, when battles involving 50 to 100 men took place.

Members of the special investigating commission were flown over Costa Rica in American supply aircraft to investigate the situation and, although they were fired at from the ground and "buzzed" by the Thunderbolt, they suffered no casualties.

More progressive in their armament plans are sundry other South American states. The Dominican Republic has asked the U.S. Government for 25 F-86F Sabres, while Venezuela has requested 22, and the Argentine 25, Lockheed T-33s. Guatemala has also requested aircraft of unspecified type and quantity.

Pembrokes for Finland

A CONTRACT has been signed between Hunting Percival Aircraft, Ltd., and Maatalousministerio, the Finish Ministry of Agriculture, for the supply of two Pembrokes to be used primarily for aerial survey and photography. Secondary duties will be freighting, air ambulance work and communications, and in the two latter rôles accommodation will be provided for six stretchers or ten passengers in rearward-facing seats. Countries now operating, or known to have ordered, Prince or Pembroke survey aircraft include Tanganyika, Siam, Switzerland, Belgium, Sweden and Finland. Additionally, there is the fleet of Princes operated by Hunting Aerosurveys, Ltd., throughout the Middle and Far East, and similar aircraft flown by the R.A.A.F. The Shell Company of Borneo has Princes with vertical camera hatches and associated equipment for service in the photographic rôle.

Plans for the Eland

THE managing director of D. Napier and Son, Ltd., Mr. H. Sammons, and the commercial manager, Mr. R. M. Hilary, recently returned from a visit to the United States. At a conference held in London last Wednesday, one of the subjects discussed was the progress and planning for the immediate future—at home and in America—of the Eland turboprop, which has reached type-test stage (a practice 150-hour run was successfully accomplished before Christmas) with only seven engines built.

In all, over 2,000 hours of bench-running have been completed, as well as 100 hours' flying in the Varsity test-bed. With the Elands in the Varsity now flying under M.o.S. sponsorship, in the pre-production Elizabethan and in the Convair 340 due to be converted by July, a considerable number of air hours should be in hand by the end of 1955.

The next stage will be to gain actual airline operating experience with the two airliners as soon as Cs. of A. have been obtained. (B.E.A. naturally have a direct interest in the fitting of Elands to the Ambassador prototype). It is planned to make the Convair 340 available for world-wide demonstration. The arrangements are already being made to despatch the aircraft to the U.S.A. for intensive trials with one of the domestic operators. Napiers are also working closely with the C.A.A., with the object of reducing the time required to obtain American certification of the engine.

The 3,000-3,250 e.h.p. Eland will be in quantity production from the beginning of 1956, and the 4,200 e.h.p. version some 18 months later. Much of the experience gained will be common in both engines. In the U.S.A., Convair, Douglas and Lockheed were all said to be considering designs incorporating the Napier Eland.

Dart-powered Hurel

COMPETITIVE with the Nord-2600, first details of which were given in *Flight* of January 14th, the Hurel-Dubois H.D.70 is likewise powered with two Rolls-Royce Darts. As might be supposed, it has an ultra-high-aspect-ratio wing and will transport 36-40 passengers. A payload of 11,700 lb can be carried for 310 miles, or 8,160 lb for 1,870 miles. Rapid conversion from the freight to the passenger rôle is "built in", or mixed-traffic operation is possible. Although Hurel-Dubois have designed a pure-jet transport, the company is now reported to have stated that "neither the application of A.T.O. jet power nor a designed speed in excess of 310 m.p.h. will be of any real advantage in connection with the high-aspect-ratio formula."

It is learned, incidentally, that as from January 1st the Société des Avions Hurel-Dubois has been reconstituted into two separate companies—the Société des Brevets Hurel-Dubois, with a capital of 30 million francs, and the Société de Constructions des Avions Hurel-Dubois, with a capital of 514 million francs.

BRITANNIA DEVELOPMENT ACCELERATES

Night-and-Day Flying Programme Under Way at Filton

IN preparation for its introduction to service with B.O.A.C., the Bristol Britannia 100 is to undergo a flight-test of unprecedented intensity. News of this programme has just been announced by the manufacturers, who, contrary to earlier plans, will not now deliver aircraft to the Corporation until the type has been awarded its full Certificate of Airworthiness.

Originally it was intended that B.O.A.C. should take delivery of the second, third and fourth aircraft almost immediately after their initial flight tests. These Britannias, with a restricted C. of A. permitting regular flights overseas but not the carriage of fare-paying passengers, would have been used for crew training and route proving, and for building up the amount of pre-service type experience required by the A.R.B. as a precautionary measure.

As things now stand, Britannias should reach B.O.A.C. with full clearance to carry passengers on regular services on completion of the normal "working-up" period of route-flying and training. The Bristol programme, in which three B.O.A.C. crews are taking part, calls for the completion of the entire Britannia flight-development schedule, including C. of A. tests, by mid-1955. Four aircraft should by then have logged 2,000 Britannia hours additional to those flown before the present programme began.

Meanwhile, a Britannia 100 "specimen", a composite structure built up from the most advanced wing and fuselage components available from the production line, is being prepared for water-tank testing by the R.A.E. at Farnborough. These trials, which are designed to establish the safe fatigue-life of the pressure cabin, will begin in late February or early March. The pressurization cycle will be repeated 1,000 times weekly, 1,000 cycles being equivalent to some 4,000 flying hours. The requirement for similar tests on the Britannia 300 is, incidentally, being anticipated by the construction of a tank at Bristol's Filton works.

At January 13th, Britannia flight time stood at 768 hr 30 min, including 51 hr 10 min logged by the second prototype, G-ALRX, before its forced landing last year. Details of the past and future flying programmes of other Britannias are as follows:—

G-ALBO (first prototype), 442 hr 45 min at January 13th. This aircraft will handle the bulk of the flying programme at a target rate of 150 hours monthly, this total being based on a "super-target" of 264 hours—i.e., a theoretical maximum of two six-hour flights between 8 a.m. and midnight on 22 days of each month. **G-ANBA,** the first production Britannia 100, had flown 274 hr 35 min by January 13th. It is scheduled to fly 75 hr monthly under the new programme. **G-ANBB** has just been completed, and will almost certainly have flown by the time these words appear; it is scheduled to fly 50 hours monthly. **G-ANBC,** the third production aircraft, should be flying within the next two or three months. It will contribute some 250 hours of route-proving flights to the development programme.

G-ALBO will, in the course of the next few months, provide valuable experience of the Britannia's response to a "commercial" rate of utilization. This applies equally, of course, to its Proteus 705 turboprops and D.H. hollow-steel airscrews. In addition, vibrograph recordings made in turbulent conditions will furnish basic data for the tank-test at Farnborough.

The first production aircraft, G-ANBA, will be used for C. of A. trials, including some performance measurements and the de-icing programme. Part of Britannia's de-icing system has been proved on a Varsity test-bed, and the amount of work remaining is not considered to be extensive. There is no question of making numerous extended flights in search of heavy-icing conditions. G-ANBB will be employed largely on handling tests —another phase of the C. of A. programme. This aircraft embodies the minor control modifications made as a result of earlier tests, and is fitted with stall-warning indication. The third production aircraft will embody these and all other modifications, enabling it to be offered to the Air Registration Board as a fully representative Britannia for the final phases of certification.

Engine hours accumulated during the Britannia programme will obviously far outnumber those obtained with the Proteus-Ambassador test-bed. Use of this aircraft, however, will permit concentration on particular aspects of power-plant behaviour without holding up the main airframe-engines-systems programme. It is now proposed, for example, to study engine icing characteristics with the aid of TV equipment for in-flight observation. Completion of the present development programme should take the Proteus flying-hours total past the 11,000 mark, in addition to the 25,000 hours' bench-running already completed.

In charge of the Britannia's intensive flying programme is Bristol's chief test pilot, Mr. A. J. ("Bill") Pegg. Following a call on Mr. Pegg at Filton last week, we can add fresh detail to this outline of the work now being performed by the Bristol-B.O.A.C. development team, which is already operating, like a small airline unit, on a dawn-to-midnight basis.

The weather problem has been overcome by the acquisition of a Decca 424 radar, which enables test aircraft returning from long flights to be talked down without delay. The weather minima applied are 300ft cloud base and 1,200 yd visibility; diversion has not yet been necessary. When we visited Filton the Decca had been in use for a month, and over that period, said Mr. Pegg, "It has given us 50 flying hours we should otherwise have lost."

Full tropical trials will be made with G-ANBA—probably in February, though the exact date of its departure has not yet been announced. High-altitude performance measurements will be made first at Johannesburg, and these will be followed by high-temperature trials at Khartoum.

The amount of preparation involved by long overseas excursions with new aircraft is not widely appreciated. The "preliminary canter" to Idris, Tripoli, last October was intended partly to uncover any unexpected problems which might otherwise have prolonged or caused postponement of the trials proper. In the event, the aircraft behaved well and its measured performance corresponded to a remarkable degree with the estimates of Bristol's analysts. In preparation for the high-altitude tests, full-weight take-offs have been made at Filton on the power which will be available at Johannesburg.

The permitted gross weight of the Mk 100 Britannia has been increased to 150,000 lb, and the aircraft has frequently been landed at weights approaching 140,000 lb—the original gross weight.

Performance calculations have proved so accurate that, to quote Bristol's chief pilot, the Britannia can be flown "from the brochure." During the recent flight to Idris the aircraft cruised, under optimum conditions, at 374 m.p.h. T.A.S.—2 m.p.h. above the predicted performance.

Cabin pressurization is used whenever possible; on occasions,

The Britannia prototype, shown being prepared for a night flight from Filton, is now engaged in a development programme without precedent in commercial aviation. Two aircraft—G-ALBO and G-ANBA—recently logged a combined total of 24 hours' test flying in one day.

(Left) The first and second production Britannias drawn up behind the three-bay assembly building. G-ANBB, the second aircraft, is seen immediately below undergoing a pre-flight test, with the first Britannia 300 fuselage visible to the right. In the third view, ground-running of Proteus 705s is seen from an unusual angle. "Flight" photographs

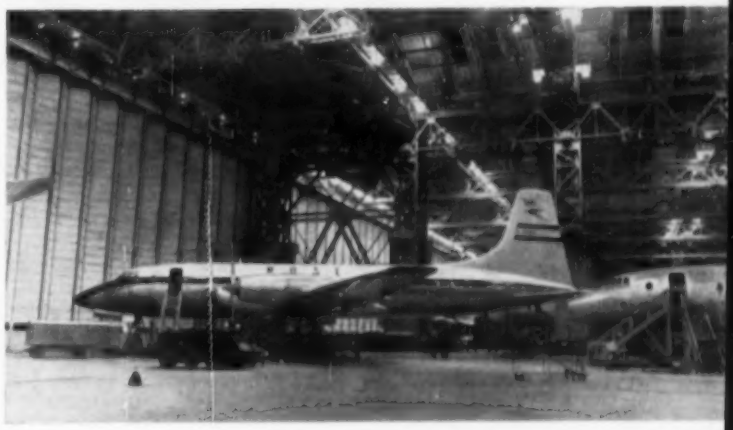
when performance measurements have been required at comparatively low levels, the equivalent cabin "altitude" has been some 2,000ft below sea level. Though the Britannia cabin was designed for a maximum differential pressure of 8¼ lb/sq in, the differential has temporarily been restricted to 6¼ lb as a precautionary measure pending further data from current research into pressure-fatigue problems.

A maximum differential pressure of 6¼ lb allows 5,000ft conditions to be maintained in the cabin at altitudes of up to 25,000ft, increasing to an equivalent cabin altitude of 10,000ft at 35,000ft. The maximum height reached by Britannias—and then only at the end of the longest stages—will be 35,000-36,000ft. Bristol's confidence in the structural design of the Britannia's pressure-cabin is reinforced, therefore, by the knowledge that it can be operated at less than its designed working pressure without prejudice to economy or appreciable effect on comfort.

Every aircraft development programme is susceptible to additions or alterations in the light of later aeronautical knowledge. In the case of the Britannia, the outstanding example is the A.R.B.'s revision of pressure-cabin test requirements, which have not yet been fully determined. It is not, however, the only example. An aircraft of the Britannia's size and technically novel concept does not achieve certification on the basis of the airworthiness and performance requirements in force at the time of its design: new requirements emerge throughout its development life, some written around unique features of the new aircraft concerned, others reflecting experience built up from the operation of earlier aircraft of comparable function. One or two examples may be quoted.

The Britannia will be the first British transport with landing distances scheduled to include the braking effect of airscrew pitch reversal. The establishment of these distances (which vary, of course, according to the landing weight and other factors) involves an exhaustive series of tests, which must take into account all the combinations of unfavourable conditions which could be met by airline pilots. It must be shown, for instance, that the aircraft can be brought safely to a standstill on a wet runway in a cross-wind with an inboard airscrew feathered; one outboard airscrew delivering full negative thrust in reverse pitch; and the other delivering full positive thrust after failure of the reversing mechanism on touchdown. This unpleasant set of circumstances has been among the emergencies simulated during the test programme at Filton.

Approach speed is another of the variables which affect landing distance. In the past, calculations have assumed that an aircraft crosses the 50ft screen at its approved approach speed, a certain percentage being added to the measured distance by way of a safety margin. Observations at a number of airports have shown that, in practice, "over-the-hedge" speeds are usually some way above the operating-manual value. This has resulted in the evolution of a "rational" or "reference" method of calculating landing distances, entailing the assumption of a higher approach speed but allowing a smaller percentage addition to the measured distance. The method has been applied during the Britannia performance trials, with the result that the aircraft has to be brought over the threshold some 15 kt faster than the approved speed for final approach; the touch-down must, of course, be made at the correct speed.



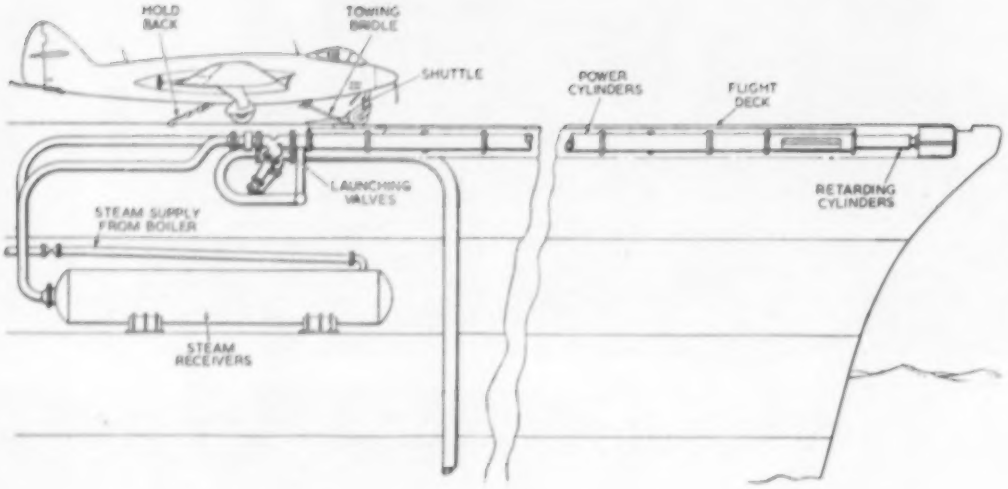
Four of Bristol's pilots, in addition to Mr. Pegg, are qualified Britannia captains. Two of the three B.O.A.C. crews (each consisting of two pilots, a navigator, an engineer and a radio officer) have taken up residence at Bristol and the third is due there next month. The first Britannia flight by an all-B.O.A.C. crew, incidentally, took place some two weeks ago.

"THE BRIDGES AT TOKO-RI"

THE film of this name, based on the story by James A. Mitchener, began its London run at the Odeon cinema, Leicester Square, last week. It is to be hoped that *Flight* readers will not be dissuaded from seeing this excellent picture of carrier life during the Korean War either by the posters advertising the film or by recollections of misguided criticism of the book.

While the photography remains carrier-borne or follows the activities of the ship's Panther squadron, the film is at its best. True, there are sequences which will cause some of our Fleet Air Arm stiff upper lips to break into a faint amused curve, but these are mainly due to differences between the British and American Navies and not to faults in the film.

Certainly the film has its faults: the problems of the pilot's wife are over-simplified in true Hollywood fashion, and much of what Mitchener wrote has had to be omitted, or only very briefly implied. But, as in the *Fighting Lady* films, the atmosphere and strange rituals of carrier flying have been well captured and, happily, the new film has no happy ending. For these reasons alone the film of "Toko-Ri" would be well worth seeing.



Diagrammatic representation of a typical layout of the steam catapult. Note how the power cylinders are housed beneath the deck, and the location of the steam receivers in which steam from the boilers is stored.

THE NAVY'S STEAM CATAPULT

ALTHOUGH the British-invented, American-adopted steam aircraft-catapult is already being applied to eight carriers of the U.S. Navy, Britain's first operational installation will be in H.M.S. *Ark Royal*, the fleet carrier expected to be completed by Cammell Laird and Co., Ltd., of Birkenhead, early this year. Catapults of this type are being built and developed for the Admiralty by Brown Brothers and Co., Ltd., of Edinburgh. They will be fitted in H.M.S. *Hermes* and H.M.A.S. *Majestic*, both of which are being built by Vickers-Armstrongs, Ltd., of Barrow; in H.M.C.S. *Bonaventure*, under construction by Harland and Wolff, Ltd.; and in H.M.S. *Victorious*, now undergoing extensive modernization at H.M. Dockyard, Portsmouth. It is the intention to replace with steam catapults the existing hydro-pneumatic catapults in all other operational carriers of the Royal Navy as production and Service commitments permit.

The steam catapult works on a principle quite different from that of the hydro-pneumatic types at present employed. The shuttle, or trolley, to which the aircraft is connected by its towing bridle, is propelled along a track in the deck by two pistons which are directly connected to it, and which slide in two cylinders placed side by side under the deck and extend the whole length of the track. An ingenious flexible-steel sealing strip, opened by the shuttle driving key and closed by a "sealing block" immediately behind it, prevents loss of pressure in the cylinder. The comparatively light pistons and the shuttle assembly are the only moving parts. The cylinder and piston assembly, and certain other features, are the subject of patents.

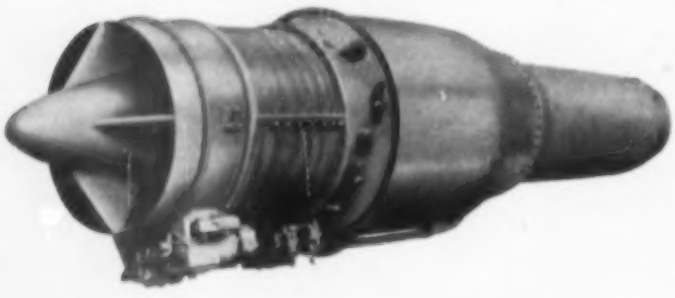
Illustrated on this page is a typical layout, showing the power cylinders housed under the deck and the steam receivers in which steam from the boilers is stored ready for the launch. Also shown is an aircraft secured by its towing bridle to the shuttle and restrained by a "hold-back" which is hooked in a suitable fitting on the deck. When the accelerating force is applied to the shuttle this, added to that of the turbojet, causes a calibrated breaking link in the holdback to break, leaving the aircraft free to move forward under the accelerating pull.

FRANCE DESCRIBES THE ORPHEUS

IT is by no means unusual nowadays to find preliminary descriptions of new British engines being published in foreign journals. The French paper *Aviation Magazine*, for example, has recently published the photograph reprinted here, which apparently shows a mock-up of the Bristol Orpheus turbojet, although we are naturally unable to confirm or deny its accuracy. The French journal has also given a number of details of the engine, including the following: diameter, 32in; length, 97in; dry weight, 850 lb; seven-stage compressor (pressure ratio 5 : 1), indicating that the engine is *not* a two-spooler; eight combustion cans in an annular space, and a single-stage turbine, the whole rotating assembly being supported by only two bearings, one at either end.

The prototype Orpheus, which first ran on December 17th last, is reported to have delivered 3,900 lb thrust at 10,500 r.p.m. with a specific of 1.1 lb/hr/lb; later on, over 4,400 lb is to be reached. Thrust-weight ratio and thrust/frontal area are given as 0.22 and 0.296 (achieved) and 0.193 and 0.205 (theoretical targets), respectively.

Presumably showing a mock-up of the Bristol Orpheus turbojet, this photograph was recently published in France. A note on this remarkably light and compact single-spool engine appears above.



PRODUCTION CONFERENCE

"INTEGRAL construction contrasted with traditional methods" was the theme of the third annual conference on aircraft production organized by the Institution of Production Engineers (Southern Section).

The conference was held at the University of Southampton on January 14th and 15th, and papers were presented by Mr. A. E. Woodward-Nutt (M.o.S.), Mr. G. W. Richards (High Duty Alloys), E. D. Keen and A. Menzies (Armstrong Whitworth), S. Radcliffe (Wadkin) and W. E. W. Petter (Folland). Speakers at the conference luncheon were Alderman R. E. Edmunds, Mayor of Southampton, and Sir Edward Boyle, Parliamentary Secretary, M.o.S. Full reports of the papers, speeches and discussion will be given in an early issue.

CANBERRA INQUEST

AT an inquest at Hertford last week on two R.A.F. officers who were killed in an accident to a Canberra on December 20th, verdicts of accidental death were recorded. The aircraft was stated in evidence to have got out of control and to have crashed on the lawn in front of a children's home at St. Margarets, near Ware, Hertfordshire. The officers who lost their lives were P/O. Raymond H. Sholl and F/O. Hubert E. Thorne.

The third occupant, F/O. C. B. Crombie, said that the accident occurred half an hour after the take-off from Bassingbourn. The aircraft had reached a height of 32,000ft and encountered "tremendous turbulence." It went out of control, performed "various manœuvres," and in the end went into a dive, turning left, from which F/O. Crombie was unable to recover. The aircraft had been difficult to control, he said, because of the bad weather, and at one stage the navigators had asked what had gone wrong. At more than one stage they had "got on their backs." He ordered the two navigators to abandon the aircraft.

As for his own escape, F/O. Crombie said that he was unable to release the control column "owing to the tremendous g-force." To release the column it was necessary to move his hand downwards to the releasing mechanism. "In the end," he said, "I knew I couldn't get my hand down, but I lifted my hand up and it was knocked back against the handle which operates the ejecting mechanism. I just ejected through the canopy."

HERE AND THERE

TRAWLED UP: A "rescued man" lies safely, if draughtily, in the new helicopter rescue net developed at R.N. Air Station Ford. The method of use is described on page 67.

Unique Honour

THE Royal National Lifeboat Institution has awarded its Silver Medal for Gallantry to Capt. Curtis E. Parkins, U.S.A.F., who, flying an S-55 helicopter in a gale, rescued the sole survivor from the South Goodwins lightship on November 27th. Captain Parkins is the first aircraft pilot and the first United States citizen to receive a R.N.L.I. medal for gallantry.

Significant Posting

AMONG recent R.A.F. appointments is that of W/C. R. G. W. Oakley, D.S.O., D.F.C., D.F.M., to R.A.F. Station Gaydon, for flying duties. W/C. Oakley has been closely concerned in the development of the Vickers-Armstrongs Valiant, and as a squadron leader was to have shared the piloting of a Valiant B.1 in the England-New Zealand Race of 1953. Gaydon, Warwickshire, is the station where the first Valiant B.1 squadron is forming.

Two-way Honours

AMERICA'S Institute of the Aeronautical Sciences has elected Sir Richard Southwell —secretary of the British Association—an Honorary Fellow, while among six new Fellows elected is Dr. William Jones, superintendent of the Aerodynamics Division of the N.P.L. In this country, this week, an American has been honoured: the Institution of Mechanical Engineers has awarded the 1955 James Watt Medal to Igor Sikorsky.

Storm Rescues

A HELICOPTER from R.N. Air Station Lossiemouth made two journeys to snow-bound villages in Scotland last week-end, one to take an appendicitis case to hospital and another to transport a maternity case. An R.A.F. Shackleton dropped supplies to the village of Braemore, near Wick, where the inhabitants had been cut off for four days. On Monday and Tuesday, five Naval helicopters—including an S-55 Whirlwind —were moved to the Wick area, and the carrier *Glory* was preparing to sail from the Clyde to act as a base for them.

AIRCRAFT ARMAMENT

NEXT week's issue of *Flight* will contain two major special features, devoted to the subject of aircraft armament. One will review guns and the other will deal with missiles, bombs and allied weapons; the articles will include the maximum of information compatible with security requirements, together with a great many photographs and drawings.

Pioneer Woman Pilot's Death

JANE HERVEUX, a pioneer woman aviator, died in a London hospital last Friday at the age of 65. She learned to fly in the monoplane in which Blériot crossed the Channel in 1909, and in the 1914-18 War served for five years with a French Air Force squadron, attaining the rank of captain. Later she gave flying instruction in the United States, and Amelia Earhart was among her pupils. The daughter of a French countess, she was married to Mr. Philip Catalano, an American now living in London.

Canadian Missile Production

MR. G. D. WATSON, an official of Canada's Defence Research Board, said in Montreal last week that the Dominion was capable of producing all the guided missiles she might need for her armed forces. Full-scale production of guided weapons for the Avro Canada CF-100 is soon to begin.

Aslib Conference

THE Aslib Aeronautical Group is to hold its fourth annual conference at Cranfield from April 1st-3rd. The main discussion will be on classification, and co-operating in the conference will be the Classification Research Group. Particulars are obtainable from Mr. C. W. Cleverdon, College of Aeronautics, Cranfield, Bletchley, Bucks.

The Viper-Trident

AFTER having its two tip-mounted Turboméca Marboré IIs replaced by Armstrong Siddeley Vipers, of 1,765 lb thrust each, the S.O.9000 Trident turbojet-*cum*-rocket intercepter prototype will soon be flying again. This is the second S.O. prototype to fly with Armstrong Siddeley turbojets; the first was the third prototype of the S.O.4050 Vautour, with Sapphires.

A Helicopter in Eire

A BRISTOL SYCAMORE—flown to Eire last week in the hold of an Aer Lingus Freighter—is giving a ten-day series of demonstrations which are expected to include a landing in the centre of Dublin. The pilot is Mr. Peter Moore. The programme was arranged by Aer Rianta, the Eireann Government holding company in Aer Lingus, to coincide with the visit to Dublin of Capt. A. Vernieuwe, vice-president (operations) of Sabena.

R.Ae.C. Film Show

THE next Royal Aero Club film show at Londonderry House is on January 25th, when the main film will be *Focus on Flying-boats*, made available by Saunders-Roe, Ltd., together with a number of short films loaned by the M.o.S.; these deal with the 1927 Schneider Trophy Race, the 1929 Fairey long-range monoplane, the Parnall Peto seaplane in the submarine M-2, and the 1934 England-Australia race. The show is for members and their guests only.

GETTING IN THE ACT: Usually reserved for fleeter forms, contrails here stream from the wing-tips of the prototype Beverley. The first production machine for the R.A.F. may have flown from the Blackburn and General Aircraft airfield by the time these words appear.

LONDON AIRPORT CENTRAL

Progress Report on the New Central-area Facilities

IN just about one month's time, if work continues according to plan, the first passengers will depart from "London Airport Central." After emerging from the sub-runway tunnel into the scene pictured above, they will proceed past the control-tower block to the passenger-handling building on the left. And there, we venture to forecast, they will be "handled" (as the authorities ambiguously put it) in a most progressive way. For this is a most progressive building.

On a visit to the central area last week, we were able to note the rapid changes which have occurred over the past few months, and also to relate the previously published plans and sketches to the sight of the actual buildings in the flesh—the hard, modern flesh of cement, brick and glass (and with the "eastern apex" building yet a skeleton).

This first phase of central-area development involves three blocks known officially as the central building, eastern apex building and south-east-face passenger-handling building. On the London Airport plan with north vertically upward these are located at about the centre, right-hand corner and bottom right-hand edge of the central-area diamond respectively.

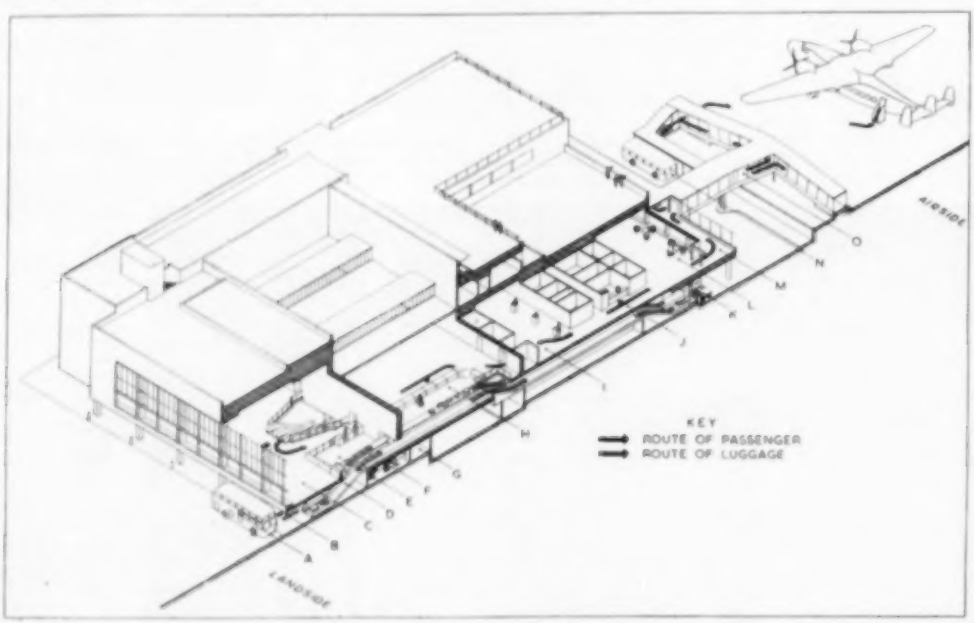
The central building is almost complete. To the exterior there remains little to be added; the Airport Commandant and a large number of the administrative staff have already moved in to their offices; telecommunications and air traffic control equipment is now being installed, but other sections are still to be equipped. In the tower itself, the glazed penthouse on the roof, 120ft high, will house aerodrome control. Below this section is the approach control room, in which the "tote"-type control information panel will be displayed, and below this the ground-movement control room. The remainder of the central building houses (in addition to the headquarters of the airport management and telecommunications) a medical centre, and restaurant and welfare facilities for the central-area staff. Completion is scheduled for July.

Approaching the "groundside" of the passenger-handling building, one notices first the six numbered entrances (Nos. 7 to 12) on the left-hand wing. These lead to six of the twelve self-contained passenger-handling "channels," ten of which have the full facilities shown in the diagram, the remaining two being of simplified type for internal traffic. These six channels only will be in use when the building commences operation in March, and they will accommodate all the Airport's short-haul European and domestic traffic with the exception of that of K.L.M. (the only airline not using B.E.A. traffic handling staff and facilities at the Airport). Long-haul traffic (together with short-haul traffic of K.L.M.) will continue to use "London Airport North" until further passenger-handling facilities are available in the central area. The south-east-face building is expected to be completed by September of this year.

As indicated in the diagram, outgoing passengers arriving at the "groundside" of the building ascend to the first-floor concourse (which extends the whole width of the building) by escalator. They then pass along the appropriate channel through transverse halls in which customs, immigration and health formalities are successively dealt with, before reaching the "airside" waiting rooms. Meanwhile, passengers' luggage travels along the channel on conveyor belts, coming up to the first-floor level as it crosses the customs hall.

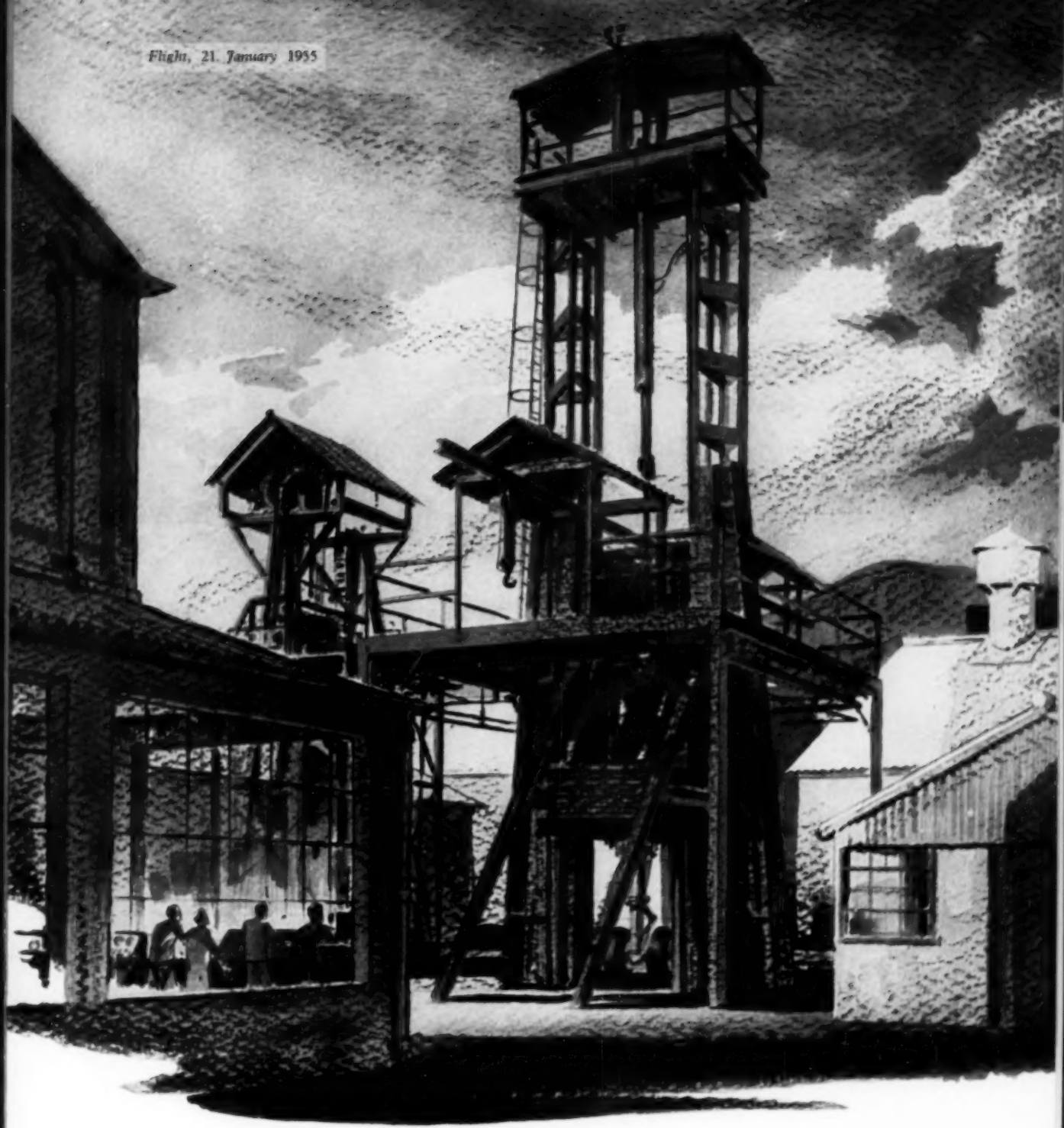
Incoming passengers travel through the channels in the reverse direction, while for transit passengers there is a self-contained suite at first-floor level on the airside of the central part of the building.

(*Continued on page* 91)



Section through a typical channel of the south-east face passenger-handling building. All channels are reversible.

(A) Passenger bus.
(B) Passenger and luggage entrance.
(C) Main passenger concourse.
(D) Luggage conveyor-belt.
(E) Processing point.
(F) Storage for advance luggage.
(G) Trucking corridor connecting all channels.
(H) Customs hall.
(I) Immigration hall.
(J) Health control (incoming).
(K) Luggage truck to aircraft.
(L) Waiting room.
(M) Airside gallery connecting all channels.
(N) Bus for outer stands.
(O) Bridge and ramps to aircraft standings, or to buses for outer stands.



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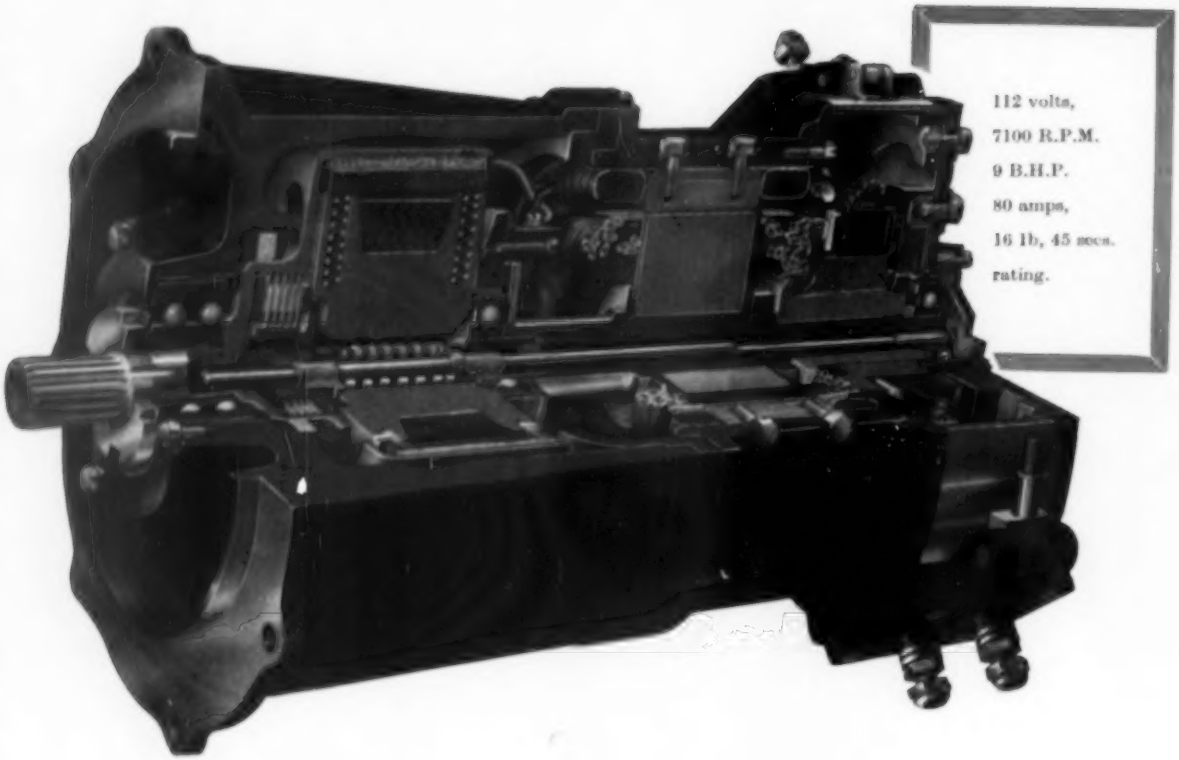

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AVIATION and PARLIAMENT

Too Many Ministers: A Plea for Rationalization in Air Affairs

"Flight" photograph

CONCERNED about the production rate of modern swept-wing aircraft for the Royal Air Force, the Prime Minister recently hinted that the situation might be improved by revival of the Ministry of Aircraft Production. This was clearly no idle thought, nor one likely to escape the attention of the Cabinet. One awaits with interest (writes a special correspondent) the outcome of their deliberations, the burden of which will doubtless be communicated by Government spokesmen when Parliament reassembles from the Christmas recess and the indicated debate is held on this controversial matter.

But it is important to recognize the extremely limited nature of the M.A.P. proposal. Such a step may or may not produce more aircraft of the appropriate quality and quantity more quickly—expert opinion seems sharply divided upon that point; it certainly will not bring any lasting solution of the problem now besetting the British aircraft industry or the British aviation effort as a whole.

That a general difficulty does exist in the matter of production seems to be recognized by Members of Parliament, whose demands for an independent inquiry have been resisted, doubtless for good reasons, by the Prime Minister. Rather less has been heard, however, of the second consideration—namely, the influence of Parliament, and through Parliament of Government, upon the general development and impetus of British aviation.

This is strange; it cannot be said that the problem is less complex, or less urgently in need of careful examination. Indeed, to study the general picture of aviation *vis-à-vis* Parliament is to discover a situation with many unsatisfactory features and calculated, in some respects, to arouse grave concern.

To put the matter bluntly, and to ignore for a moment the particular merits of particular departments, the present structure of aeronautical administration is diffuse, diverse, and even discordant. It is a structure by its very nature inimical to any real cohesion, any real force of effort, any real identity of purpose. Nor, to judge from the factual alignment of departmental responsibility, would it be reasonable to expect any other result. The departments concerned are the Treasury, the Ministry of Defence, the Air Ministry, the Admiralty, the War Office, the Ministry of Transport and Civil Aviation, the Ministry of Supply, and the Board of Trade. Merely to enumerate such a list is to display the multiplicity and diversity of functions attributable to one aspect or another of administration. That does not, of itself, imply overlapping of responsibility; but let the matter be studied more closely.

It might be appropriate to identify—very briefly and by no means comprehensively—the rôles of the various Departments, and their individual approaches to aviation:—

Treasury.—*Rôle:* General financial overseeing of aeronautical production, development, and operation. *Approach:* Involving the approval of estimates and sanctioning of expenditure, this is based primarily—and quite naturally—upon economic considerations. The approach of the Chancellor of the Exchequer is very much akin to the approach of an investor. Where conflicting interests are involved, as in the B.O.A.C. proposal to purchase American aircraft, it is open to him to weigh the short-term advantage against the long-term implication. But the basic consideration in his mind will remain the financial results at stake.

Ministry of Defence.—*Rôle:* Overall direction of Service aviation as an instrument of defence. *Approach:* To maintain a balance between the scale of financial resources available for defence and the overall requirements of defence both nationally and as implicit in membership of NATO and other organizations.

Air Ministry.—*Rôle:* To administer the Royal Air Force. *Approach:* To preserve and—where possible—advance the interests of the Royal Air Force.

Admiralty.—*Rôle:* To administer the Fleet Air Arm. *Approach:* To preserve and—where possible—advance the interests of the Fleet Air Arm.

War Office.—*Rôle:* Administration of Army Co-operation and participation in joint schemes, e.g., the Experimental Helicopter Unit. *Policy:* Apparently, to make the fullest use of aviation while retaining the possible maximum control of it.

Ministry of Transport and Civil Aviation.—*Rôle:* Administration and supervision of civil aviation. *Policy:* To develop civil aviation as a transport medium, and to maintain a certain relationship, if not actual integration, between it and other forms of transport.

Ministry of Supply.—*Rôle:* Administration of aeronautical development and research; ordering of prototypes; transmission of production orders. *Policy:* To co-ordinate, finance, and undertake research and development in accordance with Government requirements.

Board of Trade.—*Rôle:* Responsibility for aircraft exports. *Policy:* To achieve the maximum export of aircraft consistent with the dictates of strategy and diplomacy.

From the above it will be seen that, while the rôle of each department is fairly clearly defined, the interpretation of that rôle involves wide divergencies of approach reflecting the particular policies of the department concerned.

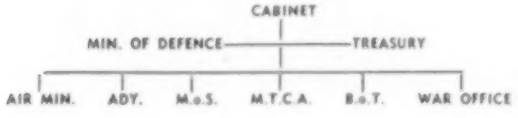
That conflict does not arise—or, perhaps more accurately, is not often seen to arise—as between department and department may be attributed to (a) the delineation of functional responsibility already mentioned (b) the co-ordinating effect, however artificial, of inter-departmental committees and other administrative devices (c) the political disadvantage of permitting departmental differences to become public knowledge.

To assert, however, that the absence of open conflict implies the presence of a harmonious cohesion in the pattern of aviation administration would be to emulate the ostrich. From a Parliamentary point of view, the diversity of interest and responsibility between department and department results in considerable overlapping. This is very apparent during the debates on Estimates, when one particular aspect of a single problem may be touched upon, but with varying emphasis, by two and even three Ministers successively. The sequence of Defence, Air, and Supply, for example, is conducive to such a result.

It is perhaps in recognition of this inherent difficulty that the practice has developed of permitting a Minister charged with the presentation of a case to include matter which, though relevant to his subject, is not strictly within the responsibility of his own department. There may be something to be said for this arrangement on the ground of expediency, but one would be ignoring human nature to dismiss the possibility that the emphasis placed on such "courtesy" matter is liable to be influenced by departmental pride and rivalry.

Another point of criticism is the matter of questions to the Minister. Because the rules of procedure are as they are—and in general they work well—the principle observed in the treatment of a question is to adhere rigidly to the pattern of departmental responsibility. It may happen, therefore, that a particular problem, in which several factors are involved, has to be dealt with not by one question to one Minister, but by several questions to several Ministers. The result is that, while the propriety of Parliamentary procedure is preserved, any collected appreciation of the problem is prevented.

This difficulty does not normally arise in respect of questions for the Minister of Transport and Civil Aviation, but a point that does arise with this department is the indiscriminate juxtaposition on the Order Paper of questions about civil aviation with questions on other transport matters. One cannot contemplate such an arrangement without serious misgivings. It might be argued, in answer to these and other detailed objections from the Parlia-



The existing arrangement of Ministerial responsibility for aviation matters and (right) the simplification suggested.

AVIATION AND PARLIAMENT . . .

mentary standpoint that, somehow or other, the system does work. But that is not the point. The real question is—does it work well enough?

Experience in recent years has surely illustrated that, whatever the merits of the system, the result has been to disperse the treatment of aviation matters in Parliament and, what is more important, to deprive aviation of any single voice on the front bench.

In general, the interests of aviation have failed to attract any collective approach—and, consequently, any creative impact—in Parliament.

If this be true of Parliament—and one would welcome a convincing rebuttal of these assertions—it follows that the same is probably true of Government. Certainly it would be surprising if any Government could achieve a cohesive view of the general pattern of British aviation when that subject figures in the portfolios of no fewer than eight separate Ministers, of whom three (Treasury, Defence and Board of Trade) are members of the Cabinet.

One is spared the need for any further speculative reflection on the point by the history of recent months with its complaints about production, demands for independent inquiries, and the suggestion of a revived Ministry of Aircraft Production.

Clearly, something is wrong somewhere. That is easily said; but freedom to criticize brings with it an obligation to advance constructive suggestions, and to perform that service is not quite so simple.

It will be gathered, however, that in this writer's view the nub of the problem lies in the complex and diverse nature of existing administrative machinery. Some stress has been placed on the absence of a co-ordinated approach. The implication—intended if not apparent—is that such an improvement would best be achieved by a rearrangement of existing machinery rather than by the introduction of additional devices of Government.

If this principle be followed, then the problem is one of selecting the basic structure about which the rearrangement is to be made. An attractive choice would be the Air Ministry. As constituted at present, this department represents little more than a "Ministry for the Royal Air Force." Even so, it is a department still dealing exclusively with aeronautical affairs, and still able to claim a pure ancestry dating from the early days of British aviation. Accepting, therefore, that the Air Ministry would become the basis of organization, the next task is to decide to what extent the aeronautical functions now performed by the other seven departments could be transferred to it.

Two obvious non-starters are the Ministry of Defence and the Treasury, both of which perform an over-all or, to coin a phrase, "big brother" rôle. Otherwise, one can visualize—and attempt to justify—the following transfers of function:

Ministry of Transport and Civil Aviation.—The whole of civil aviation. Under the existing arrangement, this department within a department could be said to operate in the right way but in the wrong atmosphere. No matter how clear-cut the administrative line of demarcation, there must always exist an elemental division as between civil aviation and transport. Further, the emphasis given to civil aviation must be conditioned to some extent by the outlook of the Minister in office—e.g., whether he be road-minded or air-minded.

Ministry of Supply.—Responsibility for aeronautical research and development, and for ordering aircraft. While not failing to recognize the Ministry's achievements in the past, one wonders whether the proposed rearrangement would not bring still greater efficiency and also an improvement in the existing state of co-ordination as between the Ministry, the Services, and the aircraft industry appears to leave much to be desired.

Board of Trade.—Responsibility for aircraft exports. At present, one gathers, this activity represents an extremely small part of the duties performed by the Board of Trade. If transferred to the "new" Ministry, it could be extended to cover not only export trade, but also to serve as a direct link between the trading side of the aircraft industry and Government.

Air Ministry.—Subject to general rearrangement.

Admiralty and War Office.—The aviation side of these departments would continue as before, but both would be represented, along with the Royal Air Force, on a planning board.

This planning board would form the operational "heart" of the proposed new structure, and would represent all functions—Army, Navy, Air Force, and the divisions of Research and Development, Trade, and Civil Aviation.

Although the above proposals are of course subject to criticism, it might be worth considering their advantages. For one thing, it would enable the Government to present to Parliament a more coherent picture of aeronautical affairs. Also, it would greatly improve the existing facilities for Parliamentary scrutiny. Only one change would be required in the present arrangement of Ministers—transfer of the Parliamentary Secretary now in charge of civil aviation from the Ministry of Transport and Civil Aviation to the "new" Air Ministry.

Administratively speaking, the least to be expected would be a marked concentration of effort and real co-ordination as between one branch of aviation development and another. Further, the very co-existence of Services and divisions dealing in the same medium would tend to produce not only an "Air" Ministry but also an "Air-minded" Ministry.

Here, then, is a possible means to an end, a possible method of giving a positive sense of direction to aeronautical administration. It is, of course, only a possibility. Other more practical solutions may suggest themselves. But the important point, surely, is to recognize that our whole future in the air is also, by its very nature, a possibility.

THE TV FILM: AIR POWER AND D-DAY

THE rôle of air power before, during and after D-Day was admirably portrayed in *Overlord*, Episode 10 of the B.B.C. Television film ***War in the Air***, which covered the great Allied invasion of Europe of June, 1944.

Preparations began over a year before the actual landing, as our reconnaissance squadrons started the immense task of photographing the coastal areas from Denmark to Spain and of building up an air portrait of France. In 1938 General von Fritsch, Chief of the German General Staff, had said: "The military organization with the most efficient photographic-reconnaissance will win the next war"; but it was left to the R.A.F. to prove it. This work reached its peak in the two months before June, when over 3,000 sorties were flown.

Information that could not be recorded by cameras was obtained by agents; this aspect of the preparations was illustrated by R.A.F. Film Unit scenes of parachutists dropping from a Halifax silhouetted against a moonlit sky.

As the chosen date drew near, the full weight of the 700 bombers and 2,000 fighters of the Tactical Air Force was turned upon the German transport system. This phase of the operations was vividly portrayed by some of the most impressive series of camera-gun shots and of raids on rail centres yet seen. The Allied light bombers appeared to be mainly Bostons and Mitchells. Brief shots of the raids as seen from the receiving end were also shown.

Nearer still to the day, the Allied air forces began to concentrate upon the heavy defensive guns emplaced all along the Atlantic Wall of Hitler's fortress, and upon his elaborate radar network. Typhoons were shown rocketing carefully camouflaged radar sites and, as the Channel was cleared of enemy shipping, a Hurricane IID (or IV?) shooting up an E-boat with its two 40 mm cannon.

D-Day eve was depicted by a fine shot of a Typhoon being loaded up with rockets and being marked with the distinctive black and white invasion markings. These markings, added to aid recognition by our own forces on the ground, were the direct result of lessons learned from earlier campaigns.

The airborne spear-head that preceded the main force was shown and included a shot of a jeep going aboard a Horsa glider and the dusk take-off of some of the many Dakota transport squadrons involved. As the main armada moved across the Channel the Allies confused the enemy by sending Lancasters to drop "Window" to give false echoes on radar sets searching near Calais. No. 617 Squadron, of "Dam-buster" fame, was assigned to this task which, although passive and unpopular with the crews, was given to them because of the exceptionally accurate navigation and flying required to give the effect of ships slowly approaching the coast.

A feature of the landing was the almost complete absence of German aircraft, although the Luftwaffe at this time totalled nearly 7,000 front-line aircraft; most of our air losses were from the accuracy of shore-based anti-aircraft guns. The control of fighter strikes from ships during the early stages was mentioned. Towards the end of D-Day, reinforcements were flown in by Horsa and Hadrian gliders escorted by *fifteen* squadrons of fighters—reason enough, perhaps, for the disappearance of the Luftwaffe! The shots of the sky packed with transport aircraft were even more impressive than those of German airborne troops screened earlier in the series.

As soon as possible, squadrons of the Tactical Air Force moved to bases in France—and particularly nostalgic were the scenes of the Lorraine Squadron moving back "home."

Before long, 30 squadrons were based firmly in Normandy. Our air superiority was complete and, as in North Africa, was used to the full. Many vivid shots were shown of fighters shooting up ground targets, including one impressive sequence of a group of German soldiers under attack by rocket-firing Typhoons.

This episode, then, was first-class; and the inclusion of only a few really spectacular shots would have enabled it to qualify for the adjective superb.

M.F.A.

FLEET-CARRIER FIGHTER

Notes on the D.H.110, now in Production for the Fleet Air Arm

Last autumn the hookless prototype conducted "touch-and-go" trials on H.M.S. Albion. The pilot was Lt.-Cdr. "Jock" Elliott, who is now with the de Havilland Company.

MANY readers will have been very glad to hear of the signing of a contract for "a considerable number" of D.H.110s. That such an order was likely was reported in our last issue; now it can be stated that the de Havilland company has received a firm "instruction to proceed," and plans for production are being rushed forward.

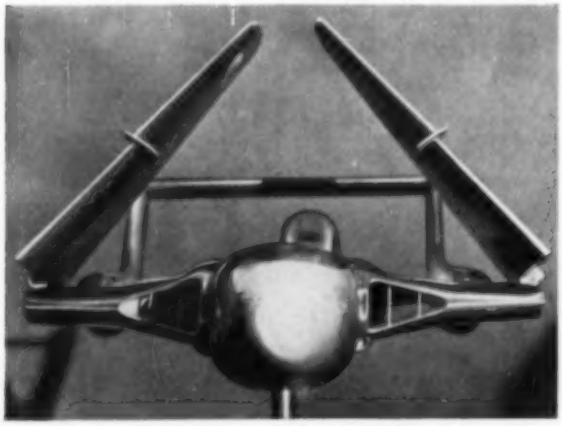
The history of the D.H.110 goes back a surprisingly long way; and, although land-based applications have never been forgotten, a Naval thread runs through the whole story and, of course, it is a Naval knot which we have on the end of it. In 1946, Mr. R. E. Bishop, then the company's chief designer, had discussions with Rear-Admiral M. S. Slattery (at that time Chief Naval Representative at the Ministry of Supply) with a view to the eventual development of a really powerful carrier-based all-weather fighter. As a result of these talks, it was decided that the twin-boom lay-out (then already a trade-mark of D.H. fighters) offered singular advantages, for it facilitated carrier stowage—one nose being pushed under the high tail of the machine in front—and made the installation of an arrester hook relatively easy.

In January 1947 a Naval design conference was held, as a result of which a requirement was issued the following June for a twin-engined all-weather fighter (N.40/46). In August 1947 the R.A.F. also issued a specification of the same general type (F.44/46) which, after much alteration, became F.4/48 in March 1948. Concurrently, the Naval specification was developed into N.14/49.

By 1949 the de Havilland company had decided to build two prototypes, principally to meet the F.4/48 requirement, and the first of these machines flew (John Cunningham, pilot, and Tony Fairbrother, observer) on September 26th, 1951. As is well known, it was powered by a pair of early Rolls-Royce Avons, and the span and length were, respectively, 51ft and 52ft. During 1952 this aircraft exceeded the speed of sound in a dive, becoming the first British aircraft known to have done so. Sonic speed had been exceeded over 100 times by the time the S.B.A.C. show was staged at Farnborough.

As most readers will know, the first prototype D.H.110 broke up in the air during that show, with tragic results. Both John Derry, the pilot, and Tony Richards, the observer, had carried out a great part of the machine's early development, and their loss was a blow which is still keenly felt.

This model of the D.H.110 is the first to show, approximately, the manner in which the wings will fold. Gun ports can be seen beneath the fuselage.



After this, the second machine stayed on the ground for almost nine months, during which time tremendous effort was devoted to ensuring that such an occurrence should not be repeated. Although details may not be given, a great deal was done to this second aircraft to improve it from several distinct aspects. Eventually, John Cunningham took it into the air again, and it has since borne the entire load of development flying—this time with a Naval order in mind—the principal pilots being John Wilson and Chris Capper. We may recall at this point that, in a leading article on February 6th, 1953, we suggested purchase of the D.H.110 for the Royal Navy.

The first impression that the 110 imparts is one of size; and yet, obviously enough, it can go down a carrier lift. It stands very much higher than does a Venom, and access to the crew stations is gained *via* a portable ladder—one being fitted on either side for the use of the pilot (to port) and observer.

The interior is pressurized and air-conditioned, and is relatively roomy and pleasant. The pilot sits well up on the port side and has a superb view, particularly to port; the observer sits slightly behind and lower down and, although he has side and roof windows, can probably learn more about what is going on by studying the numerous tools of his trade.

Starting, taxying out and taking off are what would probably be termed "above average"; equipment includes a steerable nose-wheel and toe brakes. If an engine cuts above the critical speed the 110 will climb out very neatly on one, with everything down; in fact, virtually the only effect of cutting one engine is a decrease in performance, the trim change being negligible. In the air the overall performance is so excellent that it is a pity that figures may not be given. There seems to be some justification for claiming that the 110 is more manœuvrable at transonic and supersonic speeds than any other aircraft.

Speeds well in excess of unity have been recorded on almost every recent flight, and rate of roll and turn are extremely high throughout the top end of the speed range. The entire flying-control system is hydraulically powered—even the rudders—and, in the air, the new all-flying tailplane behaves as a very powerful one-piece slab. It has not been found necessary to vary the tailplane gear-ratio for either end of the Mach scale.

At the bottom end of the scale, the slow-speed control is first class in every respect, the drooping outer leading edge—which incurred no measurable drag penalty—being of assistance. The stall is all that a stall should be, straight and "square" and with plenty of natural warning. Lowering the massive Fowler flaps unlocks what looks like an elevator from the slab tailplane, so that the trim change can be automatically cancelled out. The tail, nevertheless, retains great power for rounding-out, and the final touch-down is slower than that for the Sea Venom. Anti-skid braking will be a standard fitting.

Altogether, there is no doubt that the 110 will be one of the best-liked aircraft the Royal Navy has ever had. It is clearly an aircraft which needs a fair-sized carrier, and the fact that an order has taken so long to materialize almost certainly reflects more upon carrier availability than upon the D.H.110 itself. In service, it is to be the Navy's standard all-weather intercepter.

The production D.H.110, for which a name has not yet been officially agreed, will be armed with 30 mm Aden cannon, and it will also be able to carry air-to-air guided missiles. Furthermore, it will lift a considerable load of weapons for use in strike or ground-attack rôles. Development is currently in hand upon the incorporation of full naval equipment, including a hook, power-folding wings, catapult gear and a long-stroke undercarriage.

Most of the design load of the 110 was borne by the main design office at Hatfield. Responsibility for development is to be transferred to the company's Christchurch plant, where production will begin as soon as development has reached a suitable stage. Later, a further production line may be set up at Chester.

OPERATION RUMBA QUEEN

The Final Transfer to France, of No. 1 (F) Wing, R.C.A.F.

THE Canadian contribution to NATO defence forces on the Continent consists of one brigade group and one air division; and since November 1951 these forces have steadily been built up to their full strength. The final phase of the build-up is the movement of the first R.C.A.F. unit to reach Europe, No. 1 Fighter Wing, from its temporary base at North Luffenham to its new NATO station at Marville, in eastern France. Two of the three squadrons in the wing, Nos. 410 and 441, have already moved to Baden Soellingen and Gros Tenquin, where they are to stay until Marville is ready to receive them. The remaining squadron, No. 439, will shortly move direct to Marville, where it will be joined by Nos. 410 and 441 in time for the wing to become operational there on April 1st. Marville, a NATO base with an 8,200ft runway and facilities for fighters of the Sabre type, is occupied at present by an R.C.A.F. advance party.

The movement of the squadrons to France and Germany was a relatively simple matter. The aircraft, mostly Sabre F-86E Stars, were left in England, where they were overhauled by Airwork and then sent to the Greek and Turkish Air Forces. Despite the fact that most of them have flown for something approaching 700 hours, they are still in good condition, and constitute one of the most powerful fighter elements in the whole Mediterranean—certainly faster than anything in Malta, the Canal Zone or Cyprus. At their temporary bases in France and Germany, the first two squadrons have already been re-equipped with Canadair-built, Orenda-engined Sabre 5s recently arrived from "Random" ferry operations. Those in the squadrons who had cars drove to the Continent and the remainder were air-lifted in North Stars. No. 439 Squadron will follow a similar procedure.

The greatest problem, however, and it is one which the R.C.A.F. has not before had to face, is the peace-time transfer of all personnel and equipment from one station to another, and in this case the R.C.A.F. is making use of North Star transports to carry personnel and of two detachments of C-119F Packets to transport equipment. The Packets, four in all, have been drawn from No. 435 Sqn (Edmonton), and No. 436 Sqn (Dorval), and are under the command of S/L. R. K. Trumley. They flew across the Atlantic and are to air-lift some 300 tons of equipment and supplies direct from North Luffenham to Marville over a period of two weeks, as weather permits. The operation has been code-named "Rumba Queen." Total freight to be moved amounts to some 1,000 tons of equipment, most of which is being crated and shipped by surface transport. The Packet crews are gaining experience of European air transport conditions and by flying, so to speak, from door to door, are saving both time and money, since the freight need not then be extensively protected against the normal rough and tumble of surface transport. The Packets' average load is some 15,000 lb (of their maximum 27,000 lb) and they fly to Marville and back without refuelling. Co-ordinating the whole movement scheme is W/C. W. E. Edser, the chief Administrative officer of No. 1 Wing, and the officer responsible for marshalling and air movement is S/L. D. Warren, chief operations officer.

The first C-119F Packet is loaded at North Luffenham with stores for Marville. The tail configuration of the Packet is well suited for such operations, and fork-lift trucks make light work of loading.

The movement situation is considerably complicated by the fact that 50 per cent of all the people to be moved to France are dependents, involving a total of 400 families. This means that married quarters in France have to be found and the dependents prepared for conditions there. Schools must be set up for the children and movements arranged in such a way as to interrupt schooling as little as possible. The R.C.A.F. school at North Luffenham is to be superseded by another in France, and special married quarters are being built at Longville, 12 miles away. Marville is in a comparatively rich mining area and no difficulty is expected in finding additional living accommodation. Communism there is fairly widespread, but G/C. J. D. Somerville, commanding No. 1 Wing, is confident that good public relations work by the Canadians will eventually defeat local agitators.

The R.C.A.F.'s First Air Division on the Continent will have its headquarters at Metz, with No. 1 Wing at Marville, No. 2 at Gros Tenquin, No. 3 at Zweibrücken, and No. 4 at Baden Soellingen. It will operate as an intercepter fighter unit under 4th A.T.A.F. at Trier, under the overall control of AIRCENT. The wings at present have Sabre 5s and are receiving Sabre 6s (with a more powerful Orenda) as these are ferried across the Atlantic. So far, about 300 Sabre 5s have been flown over. It was at one time thought that the Air Division would receive some CF-100 all-weather fighter units, but Marville at least would require considerable structural alterations to accommodate the larger and more complex aircraft.

The C-119Fs are American-built aircraft acquired by the R.C.A.F. some time ago, and are powered by two Wright R-3350-32W Turbo-Cyclones, with Hamilton Standard airscrews, giving 3,500 h.p. with water injection at take-off. The main differences between these and the C-119G, which is still in production, are the latter's airscrews, made by Aero-Products.

The Packet is a typical example of thoughtful American aircraft

(concluded on page 86)

(Left) With rear loading doors already shut, ground-crewmen secure the load while the engines are run up. (Below) The Commanding Officer of No. 1 (F) Wing, R.C.A.F., G/C. J. D. Somerville, D.S.O., D.F.C., C.D., and his Chief Administrative Officer, W/C. W. E. Edser, C.D.

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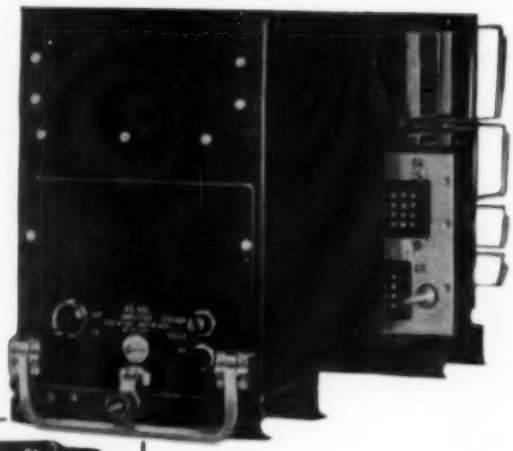

Above is the amplifier unit and the junction unit which serves as the backplate for the mounting rack of the amplifier unit, and thus eliminates cable connections between these two units. A main station box is shown on the left.

Features

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- Detachable chassis arrangement and robust construction for ease in servicing.
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A minor station box is shown above. All units are designed to fit standard aircraft racking and for easy access in servicing.

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LA 9

AIRBORNE RADAR DISCUSSED

Points from the Draft Report of the I.F.A.L.P.A. Meeting

AS recorded in "Flight" of December 17th last, airline pilots and representatives of the radar industry discussed the problems of the use of airborne radar at a meeting (sponsored by the International Federation of Air Line Pilots Associations) in London on December 10th. On this page we print some points from the Federation's draft report of the meeting. They may be amplified by reference to "Civil Airborne Search Radar" ("Flight," November 26th, 1954), in which details were given of the Ekco airborne search radar equipment and of the evaluation by United Air Lines of the R.C.A. 5.5-cm equipment.

IN the absence of Mr. C. N. Sayen, president of I.F.A.L.P.A., the chair at the "airborne radar" meeting was taken by Capt. J. Woodman, president of the British Air Line Pilots Association. During the morning session, Mr. R. S. Finke of Bendix described his company's RDR-1 airborne radar; Mr. R. F. Hansford, of Decca Radar, the Decca storm-warning (ground) radar Type 40; Mr. P. L. Stride, of Ekco, his company's airborne search radar Types E38 and E38b; and Dr. H. R. L. Lamont, of Radio Corporation of America, the AVQ-10 air weather radar. All the models described were in production.

Choice of Wavelength. This was a basic point of discussion at the meeting, the representatives of Bendix, Decca and Ekco tending to favour 3.2-cm equipment. Dr. Lamont (R.C.A.) said that his company had tackled the problem from first principles, and had based their work on the operational requirement drawn up by the (U.S.) Air Lines Electronic Engineering Committee on behalf of the American Air Transport Association, and on the theoretical studies carried out at McGill University. That approach had led them to develop airborne radar working on the 5.5-cm wavelength. The speaker was confident that the operational advantages of using such equipment more than offset the increase in power and aerial size which it demanded.

From the manufacturing point of view it was stated by those favouring the shorter wavelength that 3.2-cm equipment had been very highly developed for military purposes, its performance and reliability were known and its discrimination was undoubtedly high. It was also lighter and required less power and a smaller aerial than the 5.5-cm equipment.

Dr. Lamont, however, said that the AVQ-10 was not by any means a revolutionary piece of engineering; much experience in the use of similar wavelengths had been accumulated in connection with civil television and its characteristics were equally well known. Although it was true that a somewhat higher power was demanded, this was only a peak power and did not represent a heavy drain on the aircraft's electrical services. The weight of the equipment had been reduced from 140 lb to 120 lb and, from the point of view of reliability, during the 80 hours of storm flying in the U.A.L. evaluation, neither magnetron or klystron had had to be removed for servicing.

It was generally agreed that from purely theoretical considerations the 5.5-cm equipment should have greater powers of penetration.

Warning of Dangerous Meteorological Phenomena. Practical experience of both types had been obtained by Capt. G. W. Henderson (United Air Lines) who reported that both types would be very effective in increasing the safety of aircraft flying through turbulence. It was his conclusion, however, both from deductions made during flight and from a study of the photographic records that the 5.5-cm equipment offered certain advantages, at least in connection with his own airline's operations.

He said that United operated many short routes, of about 150 miles stage-length, and in that type of operation it did not pay them to make very extensive diversions. Thus they required airborne radar equipment for penetrating areas of turbulence and allowing the choice of a safe path through them. It was not practicable to adopt the principle of avoiding all the returns shown on the scope.

The essential information provided by the radar display was that of rainfall gradient. Whereas the 3.2-cm equipment might show two clear-cut storm-cells with a narrow unrestricted channel in between, the 5.5-cm set might well indicate a diffused area of light rain between the cells—implying a more moderate gradient. This detailed interpretation was not so readily obtained with the shorter-wavelength equipment.

Capt. J. L. Heron (B.O.A.C.) enquired whether the assumption that turbulence was directly related to rate of change of rainfall was sufficiently well-established. Mr. R. A. Jones of the Meteorological Office said that there was a proven high degree of correlation between turbulence and heavy rainfall gradient.

Cloud-echo Differentiation. All the American equipment incorporated (or was in course of incorporating) iso-echo circuitry, the effect of which was to "punch holes" in the echoes whenever the return exceeded a fixed degree of intensity. This had the effect of focusing attention towards the gradient rather than the areas of rainfall. If the periphery was narrow the gradient was obviously steep; where the hole was in the middle of a cloud formation and had a larger surrounding band of normal return, then the gradient (and hence the turbulence) was moderate.

Operational Problems. The main operational problem envisaged was that of crew complement. Capt. P. E. Bressey (B.E.A.) pointed out that in high-speed transport aircraft there was not much spare time for either the pilot or the co-pilot to look into a radar display while at the same time attending to their other flight duties. Capt. Henderson said he thought there was no crew problem: he had found it possible to leave the autopilot engaged and for the captain to look at the display and fly the aircraft, while at the same time making small corrections on the autopilot according to the course indicated between the echoes.

Desirable Range. Capt. Henderson felt that the real requirement was for a range of 150 nautical miles—certainly that was desirable for aircraft such as the DC-6 and DC-7—although a range of 50 nautical miles had been sufficient on the DC-3.

Comparison of Airborne and Ground Radar. Throughout the meeting continual comparison was made between airborne and ground radar. Mr. Hansford (Decca) said that the use of ground radar enabled much greater powers to be employed and the information gained was extremely accurate. His company had introduced a differential circuit which had the effect of splitting up a solid return and introducing a form of "shade". It was also possible to achieve a similar result by shortening the pulse-length; thus the effect was similar to that of iso-echo.

Capt. S. R. Found (T.C.A.) said that ground radar had been used extensively in Northern Maine and that, in one instance, five aircraft had been vectored simultaneously through an extensive area of heavy precipitation.

Capt. M. L. W. Wood (Central African Airways) also spoke favourably of ground radar, for conditions in Central Africa, but Capt. Henderson said that it was inadequate for the requirements of his company since it could not help a pilot actually in an area of heavy precipitation by indicating narrow channels within the cloud formation. Its use, he said, was confined to the ground station vectoring the aircraft clear of all echoes.

Cloud/Terrain Differentiation. Some concern was expressed by pilots that cloud returns might be confused with those of surrounding terrain. Under most operating conditions, however, it was thought that the sharp and "fuzzy" edges of terrain and cloud returns respectively would be sufficiently different in appearance.

Map-painting. Capt. H. J. Field (B.O.A.C.) said that airborne radar for this purpose would be most valuable, particularly for routes over under-developed areas, and for identification of coastlines, towns, lakes and mountainous regions. For really satisfactory use as a navigational aid, he thought, a range of at least 100 n.m. was desirable. Mr. Stride submitted that a power of about 100 kW would be required, using 3.2-cm equipment, for 100-mile coverage. Capt. H. W. Sherwood (T.W.A.) was particularly disturbed at the thought of making higher demands on the aircraft electrical services, unless existing generators could be improved.

Anti-collision Warning. Capt. Bressey said that pilots were becoming increasingly conscious of collision risk: they wished therefore to focus attention on the need for some technical solution to the problem. In the ensuing discussion Mr. Hansford said he could hold out very little hope for satisfactory anti-collision airborne radar for civil aircraft, and Mr. Stride commented that the technical problems were far from being solved. Both stated that the weight of such equipment would be prohibitive.

Airborne Radar for Landing Purposes. This suggestion was put forward by Capt. C. C. Jackson (I.F.A.L.P.A. technical secretary), who said that I.L.S. seemed nearly to have reached the end of its development potential. The proposal was for a 1-cm high-definition system incorporating a pictorial display—the approach pattern would consist of no more than a set of reflector screens placed as for the I.C.A.O. standard lighting bars.

Mr. Hansford thought that engineering difficulties would preclude the use of any such equipment in the air for many years to come. Mr. Finke, however, considered that the proposal was not necessarily unrealistic in view of the rapid development taking place in the industry. Capt. Jackson said that, as the screen would have to be as large as possible, rather revolutionary cockpit design would be necessary. The question was left as a suggested line of thought for the future.

These Auster A.O.P.9s—the third and fourth production machines—were tested during a recent snowy period. Production is well under way and A.O.P.9s are to be seen taking shape at Rearsby alongside various civil Austers.

AIRCRAFT INTELLIGENCE

Great Britain

Short Sherpa. After a lengthy period on the ground, during which time it has been modified in a number of important details, the Short Sherpa aero-isoclinic test aircraft has started another programme of flying, for which the pilot will usually be "Jock" Essie. This little Turboméca-powered machine has an endurance of scarcely half-an-hour, which implies quite intensive flying in order to accomplish a reasonable amount of work in each flight.

U.S.A.

Fairchild C-119. Although the name Packet dies hard, especially in this country, the Fairchild C-119 is now invariably referred to by its makers as the Flying Boxcar. The 1,000th machine of this type was delivered to the U.S.A.F. on December 22nd. Of the earlier C-82 (for which the name Packet is retained), 220 were built.

Grumman S2F Sentinel. It is reported that the S2F-2 Sentinel, and later production S2F-1s, will be fitted with a Martin-type rotary bomb-bay. The U.S. Navy is also likely to place an order for the transport version, possibly to be the RF-1 or U2F, which will carry eight passengers or 1,600 lb of cargo, and will operate from small airfields or carriers.

McDonnell F-101A Voodoo. Though measuring only 39.7ft in span, this twin-jet, long-range fighter, first illustrated in *Flight* of December 3rd, must be considered the largest single-seat fighter in the world, for the fuselage is 67.4ft long. It is learned that, notwithstanding the tremendous fuselage capacity for fuel, provision is made for carrying external tanks.

Martin B-57. The Glenn L. Martin company is reported to be completing eight sets of new honeycomb-type wings for B-57 (English Electric Canberra) light bombers. Essentially these are developments of the wing used on the Matador pilotless bomber. The aluminium sheet used over the honeycomb is said to be so thin (about 0.008 in) that it is shipped to the Martin plant rolled up in tubular containers.

Martin XP6M-1 SeaMaster. This high-speed, four-jet, mine-laying and photographic reconnaissance flying-boat, first illustrated in *Flight* last week, will be able to operate in "sea-state 3"—i.e. with waves averaging 6ft in height. The mines are released through a watertight rotary door in the hull bottom, and in their place other weapons or a camera "pod" can be carried. Whatever the load, it is fitted inside the door and exposed for operation by turning the complete door, as on the Martin-built B-57 Canberra bomber. Martin foresee good commercial possibilities for the SeaMaster, and designs for a transport version are already known to be on paper.

Piasecki HUP-4. A new version of the U.S. Navy HUP Retriever general-purpose helicopter, identified by the -4 suffix, is now flying. The engine is a Wright R1300, a seven-cylinder unit capable of developing up to 800 h.p. in "fixed wing" form and manufactured by Lycoming.

France

SFECMAS 1402 Gerfaut. After a period on the ground, this supersonic intercepter prototype has lately been flying again at Istres on a new series of trials. In the meantime, a new wing, permitting "better performances and higher speeds," has been fitted. The suggestion has been advanced that the unusual design of the fuselage—in particular the position of the cockpit—allows "maintaining the same angle of flight at the moment of crossing the sound barrier." There is as yet no confirmation that a nose plane (*Flight*, Feb. 5, 1954) has been fitted.

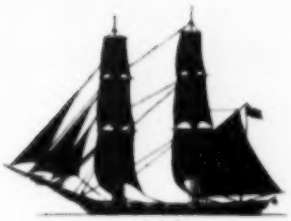
Fouga 170R Magister. Since the first flight of the prototype of this light twin-jet trainer, seven examples have been flown, and by the end of 1955 the figure should have risen to 25. By the end of 1956 ninety-six Magisters should be in the air, though it is known that production rates could be greatly increased if further contracts were forthcoming.

Breguet 960 Vultur. One of the prototypes of this carrier-borne strike aircraft (Armstrong Siddeley Mamba plus Rolls-Royce Nene) is to have its Nene removed to allow the machine to be used as a "development prototype" for a new light anti-submarine aircraft for the French Navy, designated Breguet 1050. A second Vultur is being adapted for boundary-layer control.

Marcel Dassault NATO Fighter/bomber. The Dassault entry for the NATO fighter/bomber competition bears a certain resemblance to the Fiat G.91, illustrated in *Flight* of December 31st, but has lateral Swift-type intakes for the Bristol Orpheus turbojet and a spine, running, Hunter-fashion, between the cockpit canopy and fin. Guns are mounted in the nose and rocket projectiles are slung far out under the wing, which appears to have leading edge slats. Dive brakes are located, *à la* Mig-15, on the rear fuselage.

Well over towards the vertical is this Martin P5M-2 Marlin, of the type delivered late last year to Patrol Squadron VP-47 of the U.S. Navy at Alameda, California. The open nacelle bays are for mines, bombs, depth charges or other weapons. New particulars of the latest Martin flying-boat—the SeaMaster—appear on this page.

Air Power at Sea



H.M.S. HERMES

The name *Hermes* for a warship goes back to 1796 when a brig-rigged sloop of 14 guns was captured from the Dutch as the Mercurius, and then re-named. The first aircraft carrier to bear the name served the Fleet Air Arm through its formative years and well into the second world war.

The new 20,000 ton Intermediate Fleet Carrier *Hermes* is of the new class equipped with 'angled deck' and steam catapult—these British inventions being the most important modern developments in deck flying. As with her predecessor, Fairey aircraft will be with the Fleet operating from the new *Hermes*.

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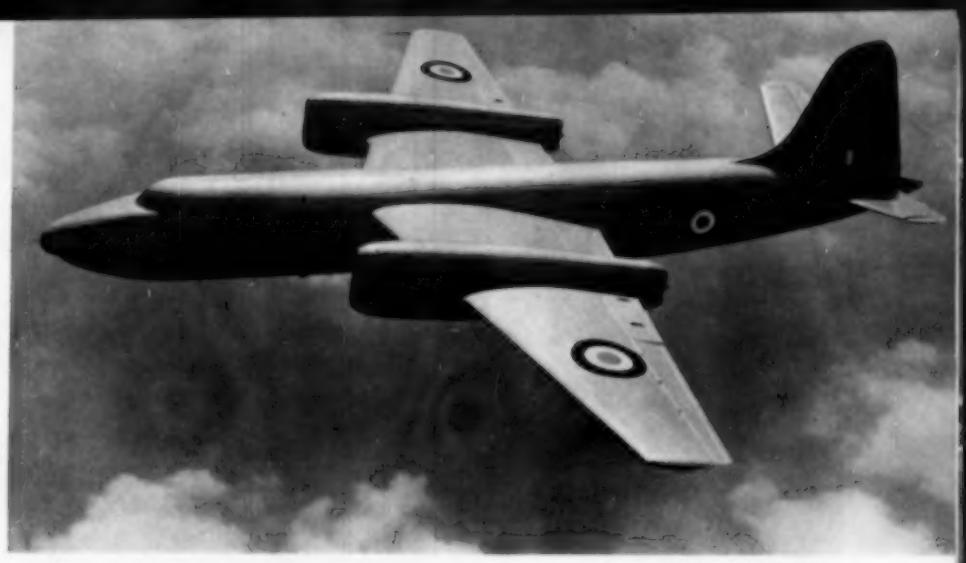
DE HAVILLAND VAMPIRE ADVANCED-FLYING AND WEAPONS TRAINER

(de Havilland Goblin engine)



Although few consider it a beautiful aircraft, the Sperrin has proved itself thoroughly capable, reliable and easy to fly and maintain. This is the first of the two prototypes, and it is now being converted by the manufacturers for use as a test-bed for the de Havilland Gyron turbojet.

"Flight" photograph

BACKGROUND TO THE SPERRIN

THE bluff, conventional and trouble-free Short S.A.4 Sperrin, designed to specification B.14/46, was Britain's first wholly new type of bomber—apart from the Vickers Windsor and the smaller Canberra—to appear in the ten years from the beginning of World War II. It is, therefore, a design of some significance. In our issue of December 17th last we published the first major description of the Sperrin, illustrating it with a drawing prepared principally to illustrate the general layout of the aircraft and the equipment which it was designed to carry. The present article, illustrated by a detailed structural drawing, outlines the history of the design from the first projected studies, discusses the experimental research which was necessary before the prototypes could be flown, and concludes with an amplification of some aspects of the final aircraft.

The basic conception of the S.A.4 (as the aircraft is best known) envisaged a four-jet medium bomber—it would previously have been termed a heavy bomber—offering almost double the all-round performance of the Lincoln, and yet having a general layout, aerodynamic shape and structure as conventional as the required performance allowed. The overall form of the aircraft crystallized during 1947 and has scarcely altered since. The reader is referred to our December 17th issue for an overall appraisal.

One of the first items to be settled in the design of a new aircraft is its aerodynamic behaviour. The S.A.4 was based upon a Mach number of 0.85, a value greater than that of any aircraft then flown in Britain with the exception of the D.H.108. That such a Mach number could quite well be achieved without sweeping the wing was clear from the outset. On the other hand, the general behaviour of the aircraft, and the type of control system to be employed, were by no means certain, and at that time Shorts were, like other British companies, poorly provided for in the matter of high-speed tunnels and similar high-Mach research equipment.

The pressure distribution around the nose was found by making a $\frac{1}{24}$th-scale nose section in which the dimensions along the wind direction were modified by the Prandtl factor $(\beta = \sqrt{\frac{1}{1-M^2}})$, equal to 1.898 for M = 0.85, so that when the distorted model was tested at low speeds—actually in the seaplane tank at Rochester—the results approximated to those for air at the required Mach number. The model was tested at 200ft/sec at incidences of $\pm$ 2.4 deg, representing full-scale incidences of $\pm$ 4.5 deg, equivalent to lift coefficients of zero and 0.5 at M = 0.85. The Reynolds number (based on fuselage length) was 9.72×10^6.

It was certainly a very sound move on the part of the S.A.4 designers to try to develop a non-powered flying-control system—although the system was originally to have been powered. As a separate drawing shows, the manual system uses irreversible screw jacks driven by cables directly from the cockpit, the jacks then actuating high-aspect-ratio servo tabs on the trailing edges of the main surfaces. This system is provided with artificial feel provided by springs, together with a pneumatic g-restrictive stop in the elevator circuit tied in with "q" (I.A.S.). The system was worked out in detail before the prototypes were built, and, as a check, a complete fin and rudder assembly of the new bomber was fitted to a Sunderland and test-flown (p. 83).

Shorts were the first company in Britain to develop a pressurized capsule for a four-jet bomber, and the compartment for the Sperrin has, it is stated, served as a basis for those of the V-bombers now in production. It accommodates two pilots, and three other crew members facing aft and working on a full-width table at the rear (see December 17th issue). A tunnel leads right into the extreme nose to communicate with the optical bombing-sighting position above the main radar equipment. The capsule is of circular section and is pressurized to 9 lb/sq in. It is so mounted in the fuselage that the top of the pressurized compartment is in contact with the outer skin, although the capsule does not itself bear flight loads.

Considerable thought was given to the problem of crew-escape. It was an official requirement that, for the prototypes at least, the first pilot had to be provided with an ejection seat, and this in itself involved a great deal of difficulty. At no time, however, did the company consider fitting five ejection seats. In June 1948—by which time the basic design was very well advanced—consideration was even given to the possibility of making the whole nose in the form of a jettisonable capsule.

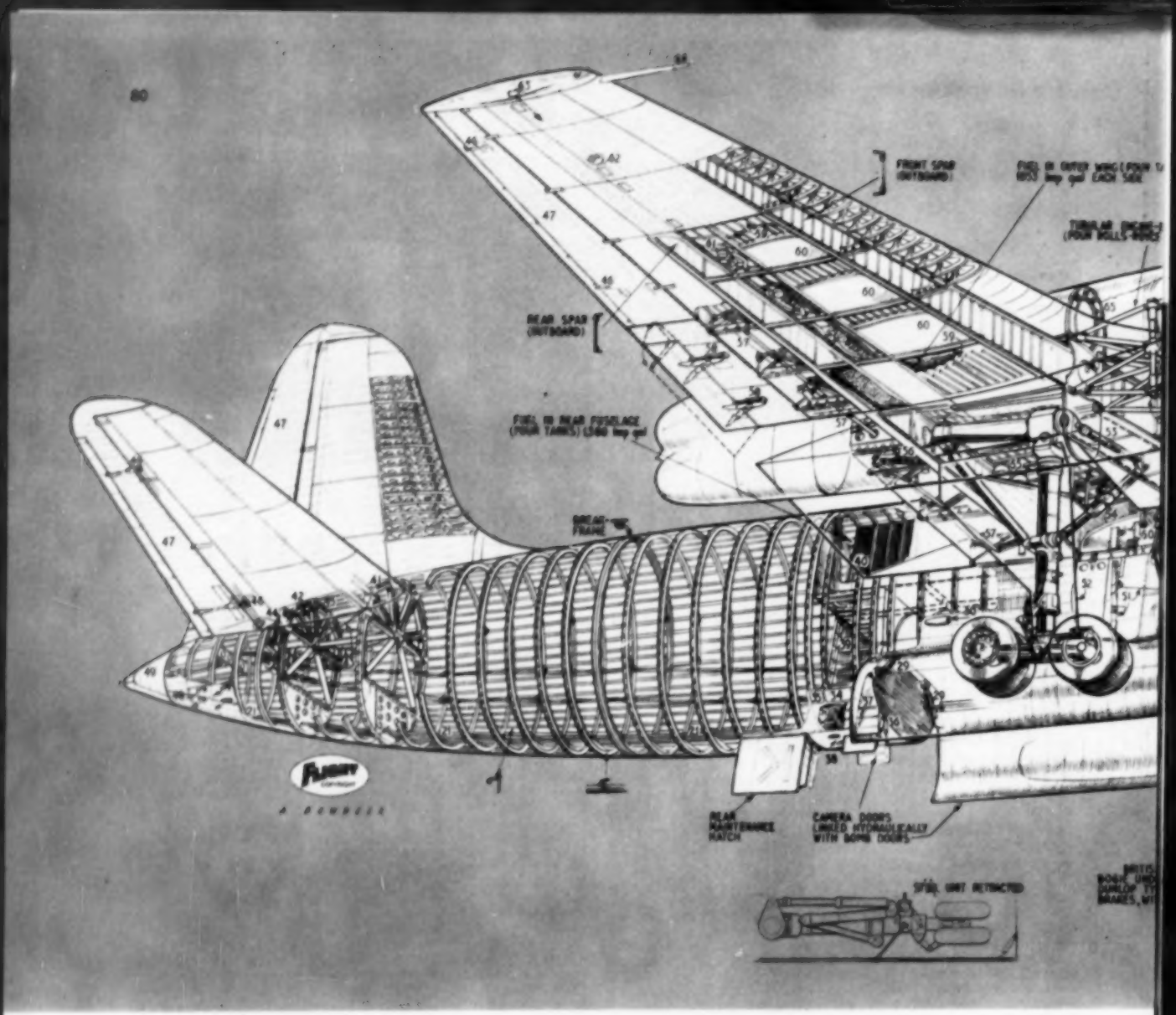
The break-line was to have been sloping, the top of the jettisonable section being shorter than the bottom, so permitting a free fall-away as the rest of the aircraft reared upwards owing to the sudden aft shift of c.g. Tests were carried out with explosive bolts, and a series of trials were undertaken on the catapult at the R.A.E., as a result of which it was decided that either ballast would have to be added to the extreme nose or fins would have to be fitted. The nose would have been stabilized by a checking drogue and—in order to get the crew into thicker and warmer air as soon as possible—would then have fallen rapidly to a low altitude before the four main canopies opened. Provision was to have been made for maintaining pressure in the nose for half an hour.

Various factors militated against adoption of the idea, chief of these being instability of the jettisonable section, shown up in tunnel tests, and the weight penalty of approximately 1,000 lb.

The scheme finally adopted was for four of the crew to leave the aircraft by way of a ventral chute—also used as the normal entrance and exit—the outlet from which was protected against the airstream by the power-opened door. Various trials with models of the arrangement were instituted, based on the calculation that the velocity ratio and time scale of the tests should vary as the square root of the scale of linear dimensions. Thus, employing one-fifth the speed and one-fifth the time scale, a $\frac{1}{25}$th-scale model could be used, this being the largest that could conveniently be mounted in the tunnel used. Again, the weight of a 200 lb crew-member could be calculated as being a function of altitude only, the speed being fixed.

Accordingly, mahogany dummy crew-members were made, ballasted with lead at the c.g., the dummy for 1,000ft-altitude tests weighing 5.98 grammes and that for 18,800ft trials weighing 10.465 gm. For simulated testing at 50,000ft, however, a dummy was required weighing 38.2 gm, and zinc alloy had to be used for this series of trials. Great care was taken to get the c.g. position and radius of gyration as exact as possible.

These dummies were then dropped through the model chute



BACKGROUND TO THE SPERRIN . . .

at speeds up to 500 m.p.h. T.A.S. or 450 m.p.h. E.A.S., at various values of g and angles of incidence. Photography indicated that the system would be acceptable.

Full-scale trials were then undertaken with the aid of the R.A.E.'s large Merlin-driven blower tunnel (*Flight*, September 10th, 1954), in the course of which flight-test personnel were blown out of the cabin and into a net. Finally, when the prototypes had been built, actual flight trials were completed, dummies being released through the chute during various conditions of manœuvre at high airspeeds with the bomb doors closed or open.

An equipped mock-up of the standardized crew compartment was made at Rochester, and this was used as a familiarization and training model for V-bomber crews.

The structure of the S.A.4 could scarcely be more conventional in its essentials, although, as will be described, a number of steps which broke new ground had to be taken. The fuselage is built in nose, centre and tail portions, each terminating in a double frame of extruded section. The frames, spaced at an average distance of 20in, are cut to accept the longitudinal stiffeners, each third stiffener (on the average) being joined to the frames. The skin panels are butt-jointed and riveted to internal butt-straps with a braided cord sandwiched between each strap and the skin.

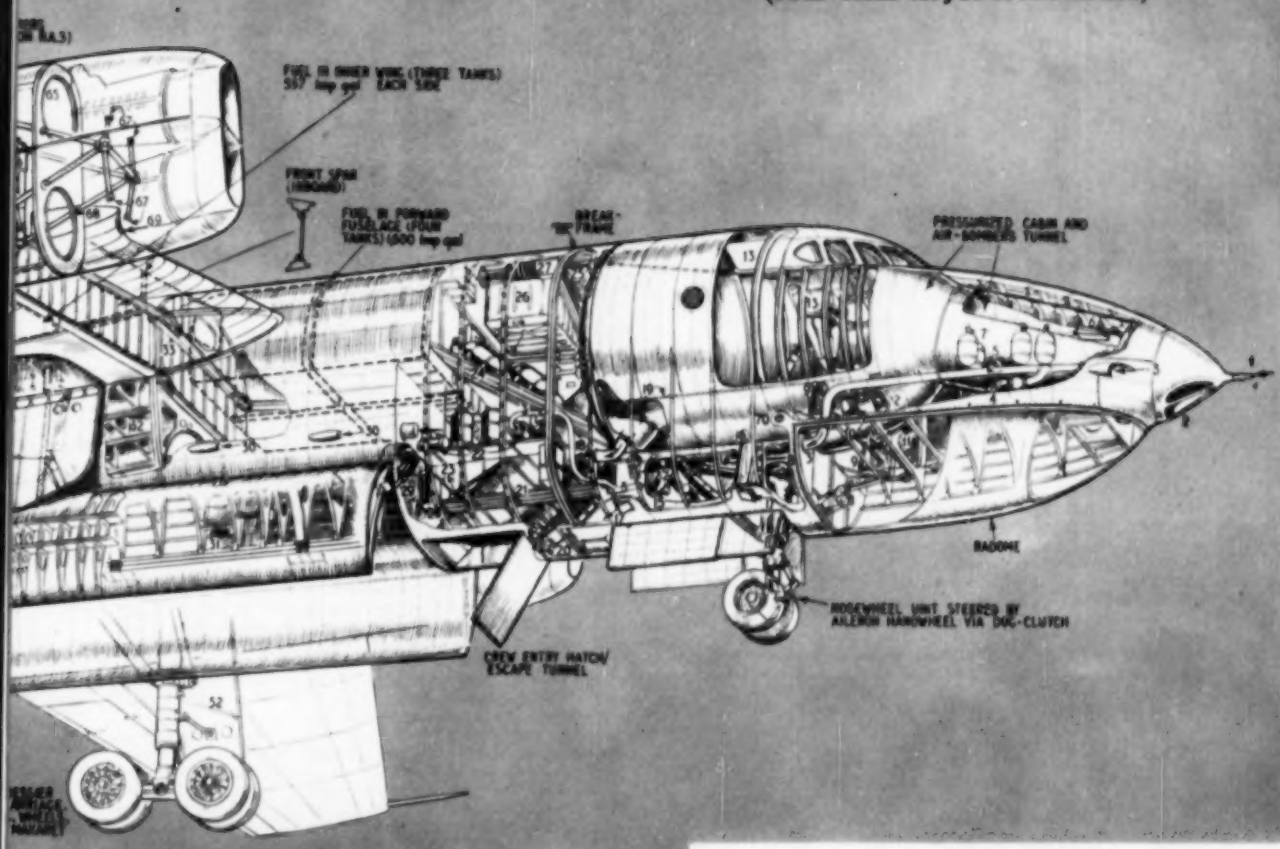
The basis of the wing is a box spar, formed from a front and rear girder connected by sheet drag-members notched to accept the spanwise stiffeners. The inner wing, out to rib five, is very massive, the basic stressing assuming a box form outboard of the nacelles, two spars at the nacelle and an imperfect box (with a cut-out for the main undercarriage) inboard.

The principal innovations during construction of the airframe were the use of D.T.D. 687 aluminium alloy (a high-strength material which, unlike the familiar D.T.D. 610, tends to shatter when overloaded), the employment of hot dimpling for skin perforations and the method developed by Shorts of milling external rivet heads and so ensuring the finest possible exterior finish.

When the company made their big move from Rochester to Belfast in 1947 the S.A.4 design was in full swing. The move undoubtedly set back the progress of the design by a least four months, but this was partly compensated for by the fact that, at Belfast, the company were able to erect a really large structural test rig capable of accepting a complete S.A.4 fuselage with stub wings. Actually, three sets of airframe parts for the S.A.4 were made, and one set was used solely for structural testing.

Initially, a complete nose section was submerged in a special tank and tested for both cabin-pressure and aerodynamic loads. With a design pressure-differential of 9 lb/sq in, the crew compartment was stressed to an ultimate strength equivalent to a differential of twice this value. During the tank testing, the pressure was increased beyond 18 lb/sq. in and, at 23 lb/sq in differential, a minor distortion of the jettison hatch over the first pilot's ejection seat occurred. This was certainly one of the first tests in the world to impose such differentials.

SHORT S.A.4 SPERRIN
(Four Rolls-Royce Avon RA.3s)


FUEL IN INNER WING (THREE TANKS) 557 Imp gal EACH SIDE
FRONT SPAR (MAGNESIUM)
FUEL IN FORWARD FUSELAGE (FOUR TANKS) 600 Imp gal
BREAK
PRESSURISED CABIN AND AIR-BOMBERS TUNNEL
RADOME
NOSEWHEEL UNIT STEERED BY AILERON HANDWHEEL VIA DOG-CLUTCH
CREW ENTRY HATCH/ ESCAPE TUNNEL

The rear fuselage was subjected to stiffness tests and was then joined to the nose section (repaired after its tank test) and mounted in the large test-frame. No tailplane or fin was attached, although loads were imparted through the root ends of the tail pick-up points. Various loads were applied to the wing stubs by means of overhead gantries, the fuselage being secured to the massive girder floor.

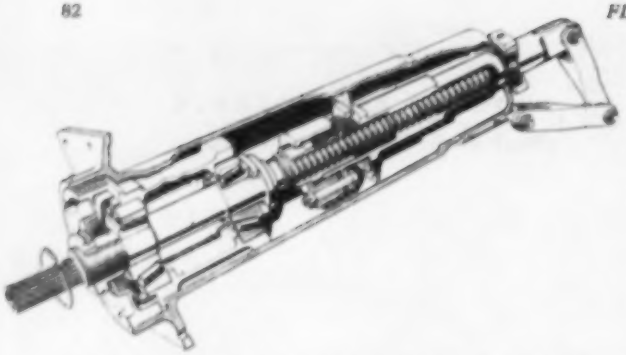
Two main cases were investigated: landing with the nose undercarriage touching first (heavily), and yawed flight at a high I.A.S. The fuselage was deliberately made as a "risky" structure with full testing in mind from the outset (this is one of several approaches to design, and is a method with singular merits). The first case examined was quite straightforward, and the highest loads were imposed in the second series of tests (yawed flight).

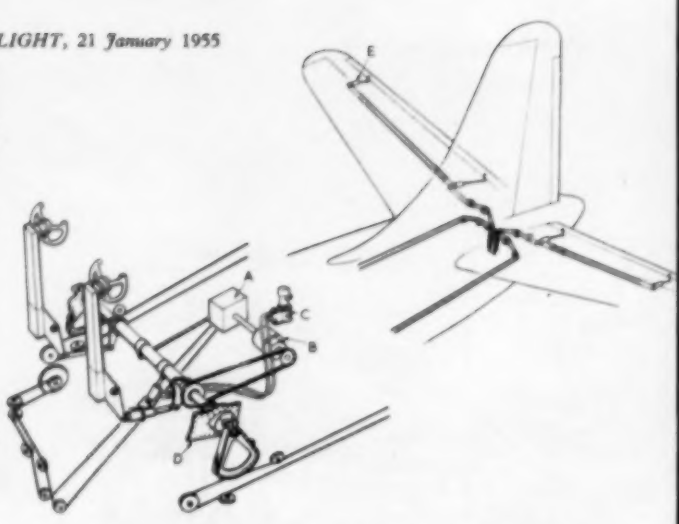
The first failure occurred at 65 per cent ultimate, in the form of a local failure in the rear fuselage. After repair, the fuselage failed again at 67.2 per cent. Progressive modification increased skin gauges and added extra intercostal members; two further tests were each stopped at 60 per cent, followed by modification, and succeeding tests went up to 70 and then 95 per cent, although it was apparent that the latter was near to the limit. At the proof conditions, the bomb doors were operated, with complete success, and the loading was then further increased, the structure finally breaking at 108 per cent.

The wing was a much more stressable structure than was the fuselage, and it was designed to be closer to the ultimate. A complete wing was attached to a short length of fuselage, and this

KEY TO DRAWING

1 Pressure head.
2 Visual bombing window.
3 Cool air to inverters above entry hatch.
4 Cooling trunk to radar installation.
5 Emergency ram-air pipe to pressure cabin.
6 Air-bomber's oxygen economizer.
7 Supplementary oxygen bottles.
8 Nosewheel-steering cables and dog-clutch.
9 Elevator torque-tube endings and quadrants.
10 Aileron control.
11 Rudder control.
12 Access to flying-control linkages under floor.
13 Captain's ejection seat and hatch.
14 Nose-undercarriage retraction jack.
15 Up-lock.
16 Nose-undercarriage trunnion.
17 Refrigeration unit intake and outlet.
18 Discharge from pressure cabin.
19 Floor level and top of escape tunnel.
20 Jettisonable hatch hinges.
21 Catwalks.
22 Inverters and suppressors.
23 Maintenance hatch in roof of escape tunnel.
24 Oxygen bottles.
25 Pressure dome (about 140 multi-pin connections).
26 H-type Mk 3 dinghy.
27 Heavy spring pulls seat into ejection position.
28 Brake reservoir.
29 Four bomb-door jacks.
30 Fuel tank air vent.
31 Ground hydraulic handpump.
32 Heavy ribs in centre section.
33 Wing/fuselage joint (four bolts front and rear).
34 Pressure-fuelling sockets, port and starboard.
35 Ground electrical socket.
36 Camera door jacks.
37 Camera.
38 Identification lights.
39 Portable ladder to (40).
40 Rear fuel-tank walkway.
41 Tailplane and fin front mounting frame.
42 Rear mounting frame.
43 Diagonal tie rods.
44 Elevator centralizing and locking actuators.
45 Rudder centralizing and locking actuators.
46 Tab-operating screw-jacks.
47 Mass- and Irving-balanced surfaces.
48 Cabin-air outlets (free flow in rear fuselage).
49 Braking parachute.
50 Undercarriage door jack.
51 Cables to door latches.
52 Leg-operated door.
53 Undercarriage retraction jack.
54 Down-lock jack.
55 Fuel recuperators.
56 Flap jack, one in each wing.
57 Flap linkage, ties port and starboard.
58 Air-brake jacks.
59 Tank-bay skin, corrugated and fabric lined.
60 Main drag members, 11 per wing.
61 Immersed fuel pumps.
62 Landing lamp.
63 16mm test camera.
64 Pressure head; static vents on fuselage.
65 Firewalls.
66 Engine trunnions.
67 Engine mount forward steadies.
68 Auxiliary gearbox inboard of nacelle.
69 Intake to cabin blower and generators.
70 Jacking point.





Typical of the servo flying-control system of the S.A.4 Sperrin is the elevator circuit, shown here. The main surfaces are moved by servo tabs which are actuated by cable-driven screw-jacks (E). Related units are the feel unit (A), the servo motor (B) and the "g-restrictor" (C). The pressure seal is denoted by D. The drawing above shows a typical tab-operating screw-jack. An irreversible Acme thread is used.

BACKGROUND TO THE SPERRIN . . .

assembly was then tested in the large rig (see illustration). Three tests were undertaken: a non-airborne take-off at maximum weight, a high-drag landing and an airborne up-gust case.

The principal trouble-spot was the web of the rear spar, in which buckling began at 50 per cent load. Slight trouble was also experienced in the root riveting, but, on the whole, the wing behaved excellently. It was finally broken at 103 per cent of the ultimate design-load, in the up-gust case at light load. The front spar failed outboard of the nacelle on one side, and the fracture then ran spanwise along the rear side of the wing tanks and passed out to the rear.

There was at this time (1950-51) some doubt about the performance of high-strength light-alloy forgings, and steel laminates were accordingly inserted in the spar-boom root fittings of the mainplane. Each of these fittings was designed to be held by a single steel bolt of 2in diameter. One point of interest is that, in the original design of the S.A.4, pains were taken to ensure that the wings and tailplane met the fuselage at right angles. Wing-root filleting was eliminated and the fuselage mould line was made narrower immediately forward of the wing. As a result, a pair of flats had to be built into the sides of the crew compartment, resulting in 50 lb extra weight owing to the departure from the ideal circular cross-section.

In its first conception, the S.A.4 had a massive main undercarriage with giant single wheels. Considerations of weight and, even more markedly, of space for retraction, caused a switch to what was one of the first four-wheel bogie undercarriages in the world (this exactly parallels Convair history with the B-36). The undercarriage design was entrusted to British Messier, and this company also developed the S.A.4's hydraulic system, which was one of the first in the world to operate at a pressure of 4,000 lb/sq in.

This hydraulic system initially provided some teething trouble, particularly in cut-outs and in "hammer," but it has since given excellent service and has been of real value in designing the high-pressure systems of later aeroplanes.

For the use of the bomb-aimer, a pressurized tunnel extends downwards and forwards into the extreme nose. In it, the bomb-aimer lies on a movable platform, as described on December 17th.

In common with almost every other aircraft fitted with a bomb bay—on either side of the Atlantic—the S.A.4 design was held up from time to time by changes in the configuration of the weapons to be carried. Naturally enough, no details of the weapons themselves can be given, but it can be appreciated that changes in the diameter or length of a store, or in the number of pick-up points, can require extensive redesign in the aircraft to accommodate it.

The prototype S.A.4s were actually under construction when it was decided to adopt a system of self-contained hydraulic jacks for lifting weapons into the bomb bay from above. Another change, made in 1948, was an increase in the size of the nose scanner, while, rather later, the scanner which was to have been mounted under the rear fuselage (for another purpose) was cancelled.

It is worth noting that, from most points of view, there seemed to be very little to chose between mounting the engines within the wing, in pods, or (as was actually done) above and below the wing in paired nacelles. When the two prototypes were built, the Rolls-Royce Avon RA.3 was not available, and the RA.2 was accordingly fitted. This involved a number of modifications to the starting controls, because electric starters were fitted. Some 12in were also added to the width of the nacelles, to accommodate anti-icing pipes. The increased width was not eventually required, and the S.A.4 has consequently had nacelles one foot fatter than was really necessary. Another modification concerned the shape of the jet-nozzle fairings; this was adopted to cure a slight tail buffet.

One of the last modifications made before the first prototype flew was to fit a redesigned form of air brake. The pattern originally specified was a single surface hinged to the trailing edge of the wing in such a manner that, when it was opened, the area opening above the wing roughly counterbalanced the area projecting below (a similar arrangement can be seen on the Vampire). In April 1950 it was decided to fit a design which would fail safe, and the present pattern was adopted, with small surfaces hinged at their leading edges and opening one above, the other beneath, the wing, on each side.

The first prototype flew in August 1951. Before it took the air, Tom Brooke-Smith (chief test pilot) carried out a great deal of taxying, during which time he learned a very useful amount about the servo flying-control system, the brakes, tyres and wheel temperatures. The first flight followed on August 10th, and served to prove that the aircraft handled well and should offer no trouble. A G.Q. tail braking parachute was used during early trials, as illustrated on p. 83.

In fact, the servo controls were not touched at all, apart from halving the gear ratio in the circuit to the elevators. Discussing the aircraft with Mr. Brooke-Smith and with his chief assistant, "Wally" Runciman, we learned that the S.A.4 is not only very simple to fly but also very pleasant.

Naturally enough, flying at heights up to well over 40,000ft involved a number of problems, largely on account of the intense cold experienced. A typical series of such troubles at one time beset the flying-control system itself. The screw-jacks, shown in the drawing above, employ Acme (square) threads on which run a split nut which can take out the back-lash. During load testing before the first flight, the system worked well at −60 deg C; but, on one actual flight, a temperature as low as −74 deg C was experienced, and the flying-control system virtually froze solid. Suspicion falling on the screw-jacks, these components were tested at various temperatures and with several types of

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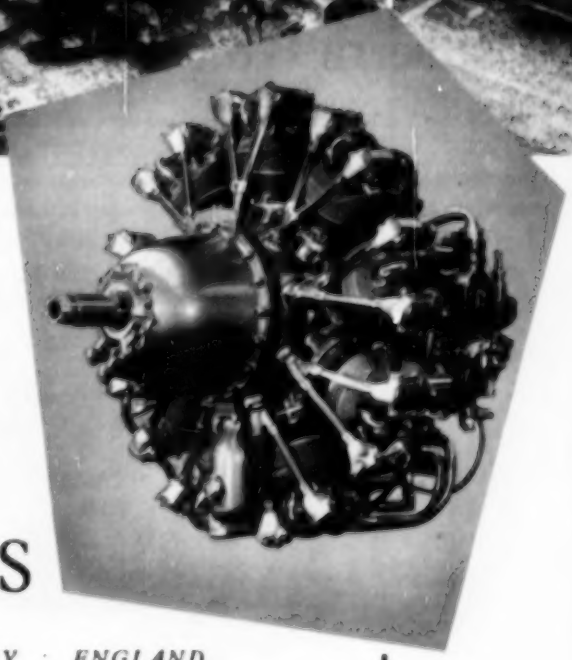

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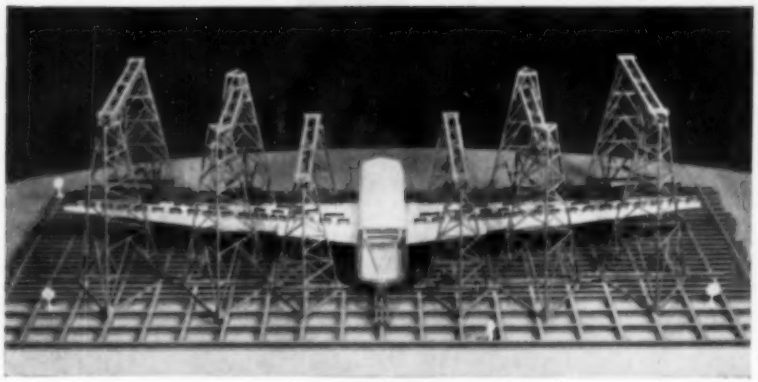
BACKGROUND TO THE SPERRIN . . .

On the right, the first prototype is shown after touch-down, with the G.Q. braking parachute system deployed. Below is a model of the large static-test frame, with the wing in position.



grease, principally to D.T.D. 825; but, although they became sluggish after one hour at temperatures below −65 deg C, it was not found possible to get the system into a rigid state. Eventually the trouble was traced to the grease used in the ball-race pulleys serving as cable guides; the normal static friction of the control system had been so low that the friction of the frozen pulleys masked everything. It was found that the pulleys worked much better at high altitude without any grease at all.

A related phenomenon was the disturbing discovery, during laboratory testing, that under certain conditions—notably at low temperatures—the irreversible screw-jacks were, in fact, reversible. This effect was traced to a reduction in friction coefficient resulting from the presence of ice. It was in such fields as this that the development of the S.A.4 paved the way for later aircraft, such as the present R.A.F. medium bombers.

Long before the prototype flew—in May 1950, to be precise—it was decided that the S.A.4 would not go into production*. Instead, the two machines then under construction were earmarked for use as flying laboratories, VX 158 to be used for the development of H,S-like radar systems and VX 161 for actual dropping trials of new types of air-to-ground weapons. In such work they were to supplement and extend the programmes undertaken by several of the Avro Ashtons.

Such has, in fact, been the case. Between them, the two S.A.4s, now named Sperrins, have logged a great number of hours of experimental flying, in the course of which they have carried out probably more series of trials than any other pair of aircraft in the country. Both machines have long been out of the hands of Short and Harland, and they have operated from such places as Boscombe Down, Farnborough and Woodbridge. The machine equipped for bombing (VX 161) was fitted with small anti-buffet flaps ahead of the bomb doors, and these have proved their worth in improving the release behaviour of some types of store.

The bomb doors are immense, and they open in the classic manner, i.e., they do not fold up internally. Nevertheless, the trim and directional stability of the aircraft remains first-class during bombing runs. Furthermore, the servo-control system permits rapid manœuvre at the end of each run and, in fact, the S.A.4 Sperrin can give several modern fighters a run for their money, even though it uses very early types of Avon (actually, the RA.3 is now fitted, but this is still considerably less powerful than the Avons used in, for example, the Valiant).

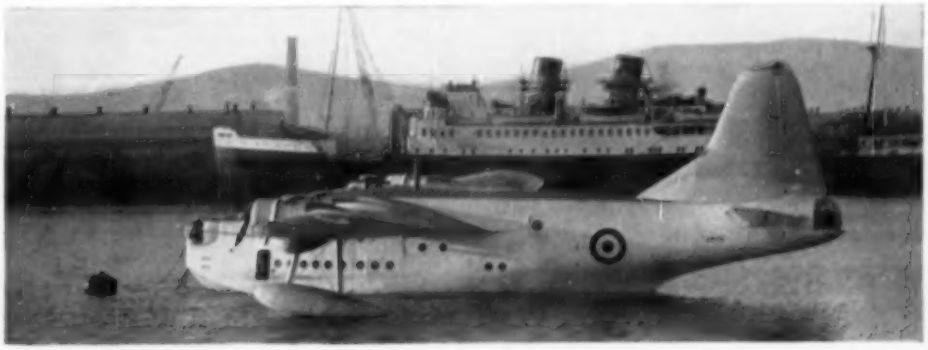
In the air, the Sperrin gives a great sense of strength, smoothness and capability. As an overall indication of behaviour, we may quote a remark that it can climb from take-off up to 45,000ft, open the air brakes, dive at Mach 0.8 with a descent rate of 20,000ft/min, and then fly at low altitude at 390 knots indicated, all without touching the trimmers. At high altitude, five degrees of flap can be selected at indicated speeds below 390 knots, in order to increase the effective angle of attack.

Tests have shown that, even at 115,000 lb, an engine cut at take-off presents no great problem. The directional change is very slight and the three-engine climb-out is adequate. Similarly, the stalling behaviour is very acceptable with no tendency for either wing to drop.

During the Sperrins' two years with the Ministry of Supply their serviceability has been excellent, and it is stated that the type has been singularly free from the difficulties met with in other aircraft of comparable performance.

There is no reason to doubt that the first machine, VX 158, will prove an efficient test-bed for the de Havilland Gyron turbojet, one of which will be fitted in place of one of the original Avons. The conversion is being done by Shorts, and the machine should fly within a few months. The work entails a great deal of internal revision to the fuel system, engine controls and the interior of the crew compartment, but details of the Gyron and of its test bed installation cannot be published at the present time.

**From the conception of the Sperrin, Shorts aimed at creating full facilities for quantity production, and the prototypes were, in fact, built in the production factory on production jigs. Had an order been placed in 1950, there is little doubt that a large number of Sperrins would now have been with Bomber Command.*



This Sunderland was fitted with a fin and rudder assembly very similar to that envisaged for the S.A.4 in order to prove the behaviour of the servo flying-control system.

Hydraulic Drive for Alternators

A Well-proved Variable-speed Transmission

IT is doubtful if there are any aircraft electrical engineers who remain to be convinced that the type of electric supply best suited to meet the power requirements of advanced aircraft is the three-phase system. Altogether, a very strong case can be made for generating current as 400-cycle, three-phase A.C. at 200/115 V; this can carry most of the load by itself, voltages being simply transformed off; where D.C. is specifically needed, a dry-plate rectifier can be used.

There is only one major difficulty in generating the power as A.C.: where more than one alternator is used—as would obviously be the case in a multi-engined aircraft—load-sharing is virtually impossible unless all alternators are precisely tied together in both phase and rotational speed. It is impracticable to keep all the engines of, say, a modern large transport or bomber all turning at precisely the same speed. In any case, electric power is also needed on the ground, when it is very undesirable to open up the main engines above a fast idling speed.

These requirements can be met by a number of types of alternator-drive system, all of which have originated in the United States. That with which this description is concerned was developed by the Sundstrand Aviation division of the Sundstrand Machine Tool Company, of Rockford, Illinois. The firm has long been famous for hydraulic control equipment of machine tools, and this work was of great assistance in developing a compact and efficient hydraulic transmission which, within wide limits of input r.p.m., is capable of maintaining the output drive to an alternator at a constant rotational speed.

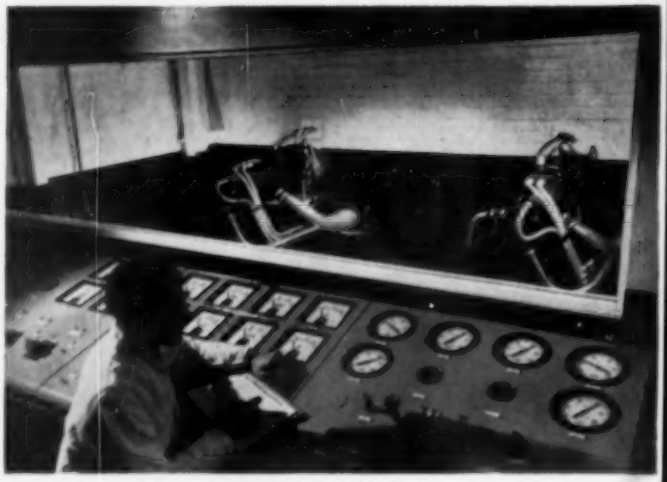
The basis of the system is that the input shaft drives a variable-displacement hydraulic pump which supplies oil to a hydraulic motor mounted on the output shaft. Pump and motor are mounted in the same housing, as a differential system, so that the pump/motor assembly handles only the power represented by the difference between the input and output speeds.

Both pump and motor are of the multi-plunger axial type. The plungers of the pump are moved over a stroke which varies infinitely between two maxima (passing through zero) according to the angle of the driving swash-plate. In contrast, the swash-plate driven by the plungers of the hydraulic motor has a fixed angle. Between the two sets of plungers are positioned a pair of valve plates—one mounted on a fixed axis and the other, separated by a port plate, carried on an eccentric axis rotating with the motor—which direct the oil flowing between the pump and motor.

The input shaft drives the main pump/motor cylinder block, as well as the make-up and scavenging pumps. The make-up pump is required to prime the plunger assemblies and ensure that they are maintained full of high-pressure oil. As the main plunger assemblies rotate, the pump swash-plate takes up an angle governed by the relationship between the under-drive and over-drive control pressures. According to the output from the plunger pump, the plungers of the motor are fed with high-pressure oil, and they therefore impart a clockwise torque to the fixed-angle output swash-plate.

The output swash-plate can rotate independently of the main plunger assembly, and the governing system is such that, until the output speed reaches 6,000 r.p.m. (or whatever speed is required by the characteristics of the alternator), the pump swash-plate remains in the full-stroke position, in which the hydraulic supply tends to speed up the output compared with the input r.p.m. There is, of course, a minimum input speed below which the required output r.p.m. cannot be obtained.

When the required output speed has been established, nothing further happens until the input speed is increased; when this occurs, the over/under-speed governor pressure reduces the pump swash-plate angle so that the pump delivery is reduced. This has the effect of reducing the differential speed between the cylinder block assembly and the motor shaft, so maintaining the correct output r.p.m. When the input speed is equal to the required output speed, the pump delivers no oil, and the unit behaves as a direct drive. Further increase in input r.p.m. reverses the pump swash-plate angle, so that the original motor behaves as a pump while the pump meters back the oil in a reverse direction.



This photograph shows a pair of Sundstrand-made drives on test with 40 kVA alternators at the Napier factory at Acton. These units have been subjected to the test schedule shown in the table opposite.

The whole system is self-contained, and fits approximately into a 15in cube. The weight of the unit varies according to the application, but 70 to 80 lb is a fair average.

The arrangement was steadily developed during the years immediately following World War 2, and it early attracted U.S.A.F. interest. The obvious attractions of a fully paralleled A.C. system were so great that, after protracted testing, the company were given a production contract.

By far the most important application in the early days was to the great Convair B-36, in which Sundstrand units have now completed hundreds of thousands of hours. In this aircraft, six alternators are fitted, one being driven off the forward-facing "rear" end of each of the pusher piston-engines. The hydraulic drives are accessible from inside the wing; in fact, if one engine at a time is shut down to reduce the airflow through the wing, they can be reached in flight.

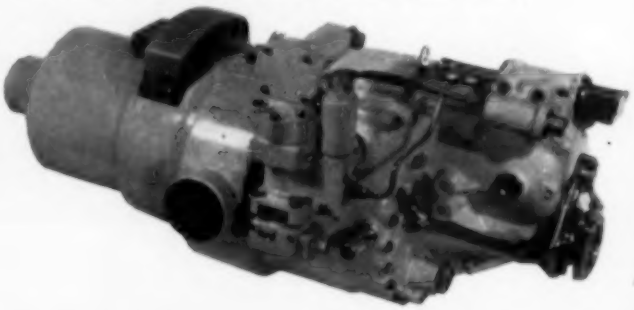
There is now a strong core of Strategic Air Command flight engineers who have become so used to having a load-sharing A.C. system that they take it for granted. In recent years, we believe, the Sundstrand units have given virtually no trouble and their overhaul life is high. All the worst snags were eliminated in the early days; and the B-36, which can cruise at 45,000ft for over 30 hours, is certainly an arduous test-bed.

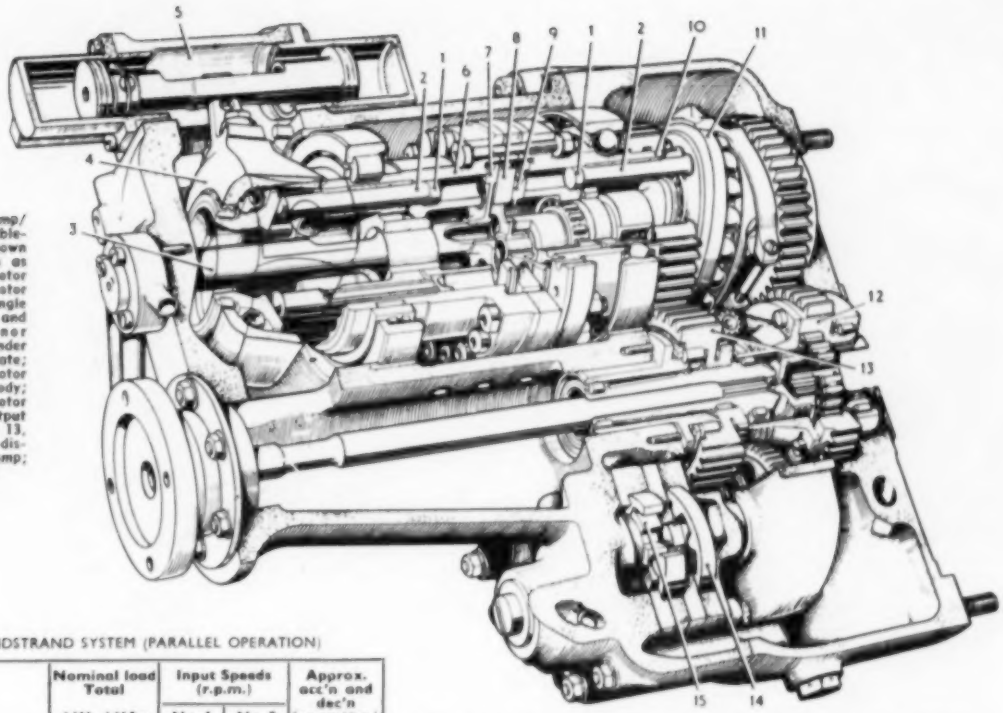
Sundstrand have now developed a whole series of hydraulic drives tailored to fit individual types of engine and aircraft. They can be mounted either on an engine—wherever a drive pad can best be placed—or on the airframe, and types exist which are not dependent on engine oil but have a self-contained hydraulic system. Several new types of aircraft, notably the Douglas B-66A (two Allison J71s), are now coming into service with the drive.

It was announced last year that the English Electric company had concluded an agreement under the terms of which the British company will manufacture and market an anglicized version of the Sundstrand unit. During the past year, the company's Bradford factory has been handling the new device, while the actual test-bed running (to obtain an independent check on the performance of the American-made equipment) has been carried out by D. Napier and Son, at Acton (Napier are members of the English Electric Group).

The unit with which English Electric are immediately concerned is that for a 40 kVA alternator, which is maintained at

A typical 40kVA alternator (on the left) and hydraulic drive.





The basic hydraulic pump/motor unit of the variable-ratio drive is here shown sectioned. The key is as follows: 1, 2, motor plunger; 3, main rotor shaft; 4, variable-angle swash-plate; 5, over- and under-speed governor cylinder; 6, plunger cylinder body; 7, pump valve plate; 8, port plate; 9, motor valve plate; 10, motor body; 11, fixed-angle motor swash-plate; 12, output clutch and drive gear; 13, input gear; 14, fixed-displacement charge pump; 15, scavenge pump.

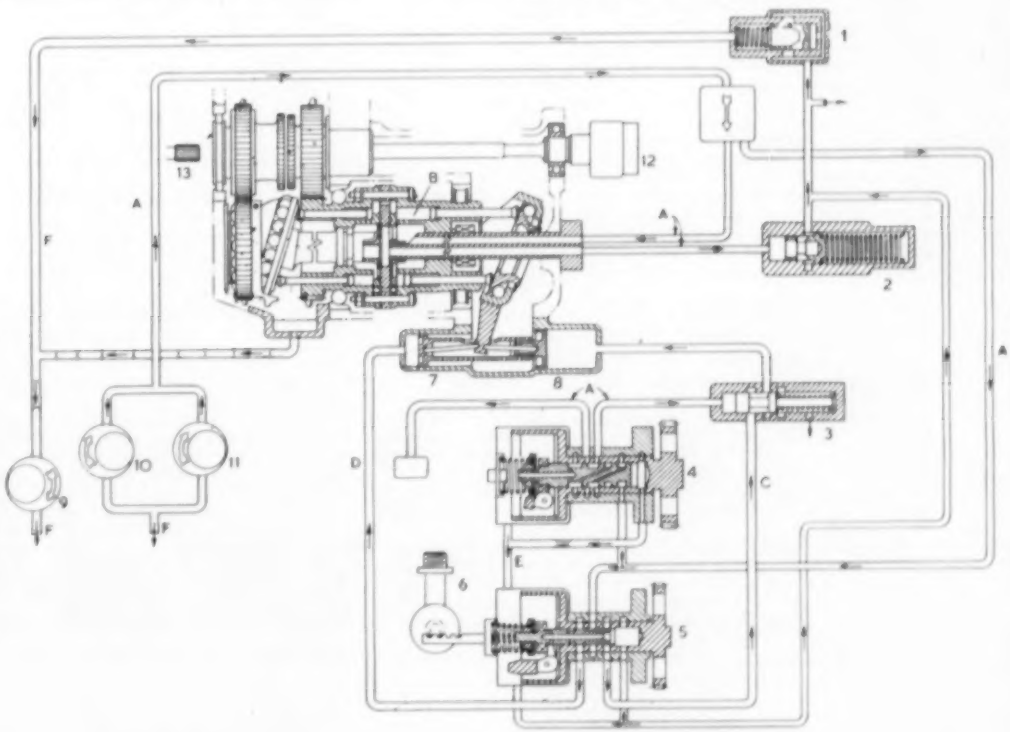
TEST FOR SUNDSTRAND SYSTEM (PARALLEL OPERATION)

Case	Nominal load Total kW	kVAr	Input Speeds (r.p.m.) No. 1	No. 2	Approx. acc'n and dec'n (r.p.m./sec.)
Parallel alternators with load on one only	16	—	5,000	5,000	—
Load switching up to 80 kVA	16	—	5,000	5,000	—
	16 +	Pulse	,,	,,	—
	32	—	,,	,,	—
	32 +	24	,,	,,	—
	48 +	24	,,	,,	—
	48 +	48	,,	,,	—
	64 +	48	,,	,,	—
Full-load acceleration and deceleration	64	—	5,000 to 8,000	5,000	1,000
Half-load acceleration and deceleration	32	—	5,000 to 8,000	5,000	1,000
"One-up, one-down" ...	32	—	8,000	4,000	—

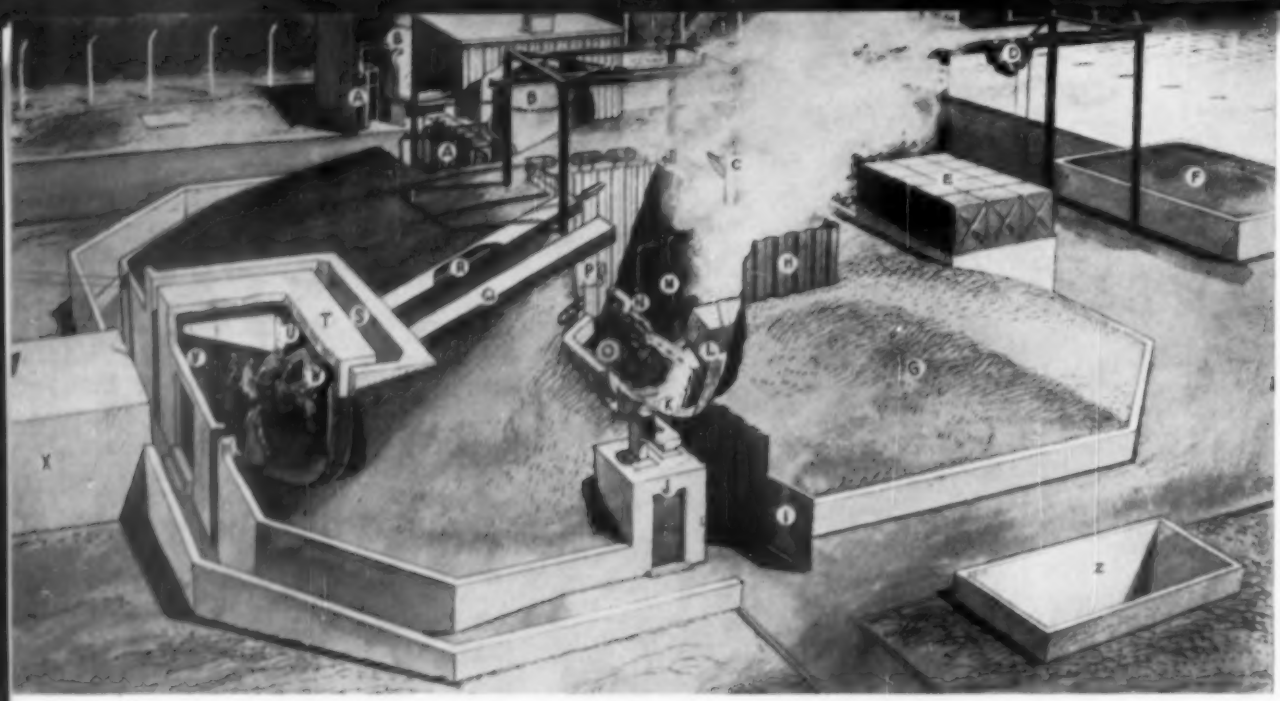
6,000 r.p.m. (400 c.p.s.) between input-speed limits of 3,000 and 8,100 r.p.m.—values well suited to most of the larger modern aero engines. Under a rapidly accelerating input speed, the alternator frequency can be maintained within 5 c.p.s.; in steady conditions, better than unity is attainable. As for load-sharing in a paralleled system, 14 kW is the maximum out-of-balance during sudden changes in input r.p.m. or supply load, and this is reduced to 4 kW under steady conditons.

The test set-up at Acton, which was demonstrated publicly yesterday, January 20th, consists of a pair of English Electric/Sundstrand drives, each coupled to a blast-cooled 40 kVA alternator. The two alternators are connected to a common bus-bar, which feeds a system of various resistive and reactive loads upon

(concluded at foot of next page)



This diagram shows, in schematic form, the basic components and circuit for the English Electric/Sundstrand drive. The key is as follows: A, charge pressure; B, working pressure; C, overdrive control pressure; D, underdrive control pressure; E, oil pressure; F, vented to atmosphere. 1, oil relief valve; 2, charge relief valve; 3, overspeed trip valve; 4, overspeed governor; 5, basic governor; 6, frequency-control motor; 7, underdrive control cylinder; 8, overdrive control cylinder; 9, scavenge pump; 10, 11, output- and input-driven transmission charge pumps; 12, input spline (internal); 13, alternator drive.



(A) CO_2 for fire-extinguisher system.
(B) Liquid oxygen storage tanks.
(C) Observation mirror.
(D) Gantry for installing motors.
(E) Water reservoir.
(F) Fuel storage tanks.
(G) Earth and grass embankment.
(H) Interlocking steel piling.
(I) Door to test cell, shut during tests.
(J) Ventilation fan room.
(K) Water to protect "hot" end of cell.
(L) Baffle to shield piling.
(M) Water supply for sprinklers, washing down, etc.
(N) Liquid oxygen supply.
(O) Rocket motor under test.
(P) Flameproof light.
(Q) View-way to mirror.
(R) Periscope.
(S) Safety gap.
(T) Control room.
(U) Recording-instrument panel.
(V) Camera photographing instrument panel.
(W) Control panel.
(X) Transformer and electrical switchgear.
(Y) Test warning flags.
(Z) Trap to separate waste paraffin from water.

The rocket test cell, cut away to show the general layout—an Armstrong Siddeley artist's impression.

ROCKET TEST HOUSE

BEARING in mind the nature of the fuels and oxidants commonly employed in rocket development work, and the pressures and temperatures attained, the fact that accidents are few is a tribute both to designers and to the suppliers of the constructional materials used. Nevertheless, it is obvious that all possible precautions should be taken for the safety of personnel, and an excellent example—the new rocket test house now in use by Armstrong Siddeley Motors—is illustrated here.

It may be recalled that our detailed description of the company's Snarler rocket motor (August 6th, 1954) included a floor plan of the earlier building in which much of the experimental work was carried out. In this, the observation and control room immediately adjoined the test pit, the motor being observed through an armoured glass window, as in normal turbojet test cells. Later, the safety margin was increased by substituting periscopic sight for direct vision. In the new test house, as will be seen from the drawing, this method of observation has been carried considerably further—to such an extent, in fact, that the control room is isolated from the test pit by a 20ft-thick earth embankment, a concrete wall, a safety gap, and finally the concrete wall of the room itself. In addition, the walls of the test pit are made of interlocking steel piling. The safety gap is designed to insulate the observation room from direct shock, and it is estimated that a 1,500 lb charge of high explosive could be detonated in the pit without harming people in the room.

As will be seen from the drawing, visual observation is made both by means of a submarine-type periscope and with the aid of a mirror which, mounted high up on the wall of the pit—provides a view of the farther side of the motor. Incidentally, whereas no mention is made of methanol—the Snarler's fuel—the presence of a paraffin separator suggests that the successors to this motor may be designed to use aviation kerosine.

When details of this new test house were released last week Armstrong Siddeley's spokesman said that pilots were encouraged to come and watch the rocket motors with which they were going to fly—"When they are in the test house we say to them, 'take over the controls, mishandle them as much as you like, and see if you can break the motor up.' No one has yet succeeded in doing so." Mr. S. Allen, in charge of rocket development, has said, "Once a rocket motor is developed we are prepared to stand beside it, without any protection whatsoever, whenever it is running."

As remarked in the previous article referred to above, the company decided a year ago that there was such a big future for rocketry that it was worth forming a new Armstrong Siddeley Rocket Division, with headquarters at Anstey. In addition to the new test house a large laboratory has been added and equipped.

HYDRAULIC DRIVE FOR ALTERNATORS

(*Continued from previous page*)

which can be superimposed an 8 kW pulse which is "on" for 40 milliseconds in each half-second, to simulate a radar supply. The system is controlled by American voltage regulators and frequency control units, which actuate the frequency control motors (see schematic diagram), to maintain the correct conditions without "hunting." The drive is obtained from a pair of large petrol engines (Rover Meteor tank engines, of Merlin heritage), and the oil for the hydraulic drives (to D.Eng.R.D.2487) is taken through an external circuit. The unit has also been run on various water-based fluids.

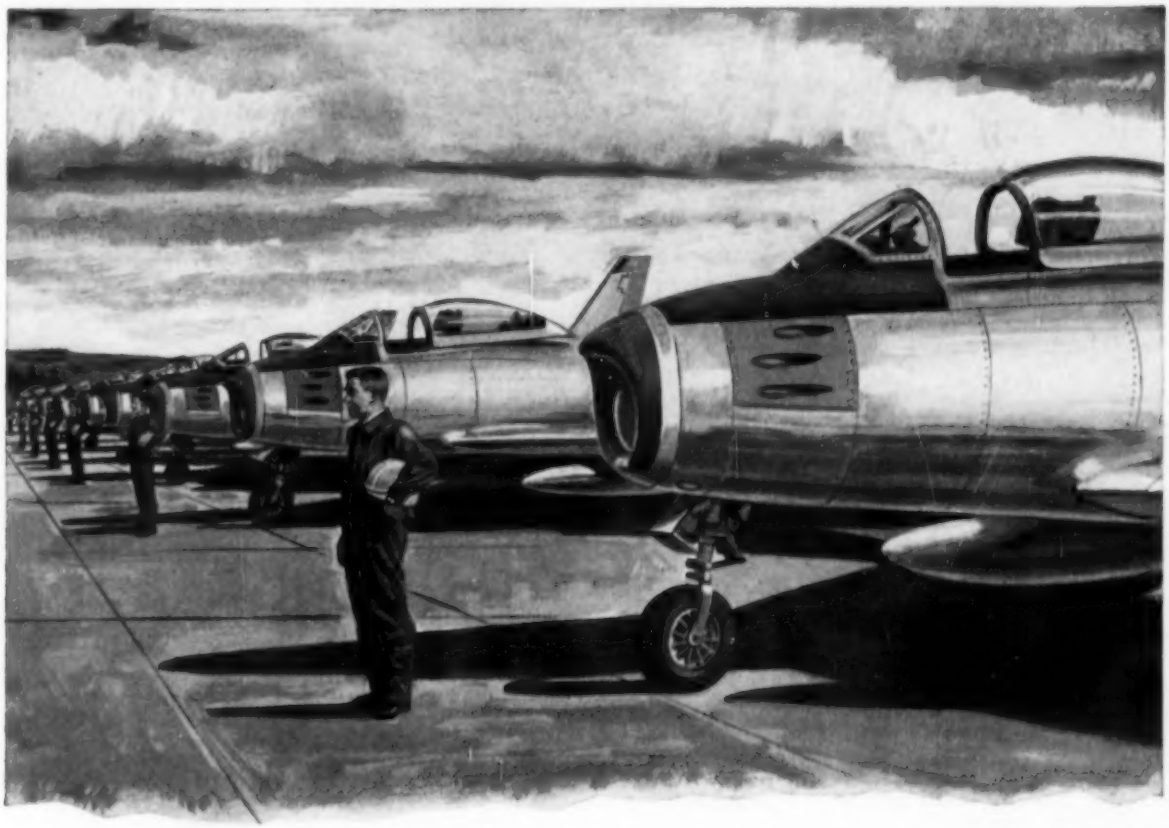
Altogether, English Electric consider that the performance claimed by Sundstrand is fully met, and it is intended to put the drive into production at the large Napier factory at Netherton, Liverpool. It can be assumed that this decision would not have been taken if production orders had not been placed.

OPERATION RUMBA QUEEN

(*Continued from page 76*)

design. The cockpit is extremely well arranged for a four-man crew, with excellent instrumentation and control layout in the American style, and green background colouring. A gay touch is provided by tartan seat covers and head-rests. The main cargo floor is large and unencumbered, with the walls of the hold fitted to carry all the necessary lashing equipment and tools and even a number of stretchers. The ceiling carries a gantry for dropping para-containers through the forward floor hatch and roller-conveyors can be mounted on the floor for dropping heavy equipment. Direct lorry-to-aircraft loading is possible since the cargo floor is at vehicle level and, of course, easily accessible to fork-lift trucks. These were, in fact, being used exclusively for loading at North Luffenham. The capacity of the Packets is such that it was considered that the entire station could have been moved by air by six or eight aircraft working for three weeks.

Here's a Story that's almost a Tradition...



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An A.P.U.'s 500 Hours

Solar Mars Stripped for Examination

GLOBEMASTERS of the United States Air Force are equipped with auxiliary power units in the form of 14kW generator sets driven by Mars gas turbines produced by the Solar Aircraft Company of San Diego. More than 90 of the aircraft have been so equipped to date, and the auxiliary power units have operated for a total of more than 22,000 hours with no more than normal maintenance. In July of last year the first unit to complete 500 hours of operation was removed from an aircraft at Palm Beach Air Force Base (*Flight*, August 13th, 1954, p. 201) and a detail report on the condition of the components has since been prepared. Since July four more have exceeded 500 hours.

The first unit was delivered to Douglas Aircraft on August 12th, 1953, for installation in an Air Force C-124C. Experience at various U.S.A.F. bases has indicated that the normal ratio of A.P.U. to main engine running hours is about three to five, but the first generator set to complete 500 hours had been maintained on almost constant duty during Globemaster conversion training flights. It had provided power for all electric equipment while the aircraft was in use on the ground. It was kept on stand-by duty during take-off and climb, and in flight it was in more or less continuous use as a source of emergency power for practice procedures. The unit also provided the power for airscrew pitch-change and reversal when the main generators were idling.

The A.P.U. is delivered by the U.S.A.F. for inspection by Solar. It is seen being lowered on the power hoist of a C-124C Globemaster; the hoist and the cargo doors are among the services for which Mars A.P.U.s provide electrical power.

Performance calibrations based on fuel consumption *versus* horsepower and turbine inlet temperatures *versus* horsepower which were made after 500 hours of operation are reported to have shown a deterioration in performance of less than 2 per cent.

The Solar Mars auxiliary power unit after completing its 500 hours. These compact little units generate a continuous output of 14 kW, running on the aircraft fuel, and weigh about 230 lb complete.

The following information is given about the condition of individual components. The turbine of the Mars, of radial inflow type, has a rotor of forged Timken alloy. In this there were no signs of cracks or change in hardness, and the growth in diameter was only 0.0008in. So far as the inspection department was concerned the rotor was acceptable for further use, but on principle this course was not recommended by the makers, pending further operational experience. Portions of the turbine scroll showed signs of burning in the form of thinning by some 0.004in in 0.032 material. The turbine nozzle area had increased by 0.25 per cent, supposedly due to the scrubbing action of the hot gases, and this contributed to the development of gaps of up to 0.012in on the trailing edges of the nozzle vanes. The nozzle was still serviceable.

The burner, and the silicone-impregnated glass-fibre bellows between compressor and combustion chamber, showed signs of excessive deterioration, and heavy lead deposits in the burner, coupled with evidence of erosion and corrosion in the lower portions of the mixing chamber, indicated that the burner had been in operation for at least 300 hours despite the normal replacement expectancy of 250 hours for this part.

The compressor impeller and bearing assemblies, which operate at 36,000 r.p.m., were found to be free from flaws. As with the turbine, the compressor impeller was found acceptable for further use, though such use was not recommended at this stage.

All major reduction gears (36,000 r.p.m. to 4,500 r.p.m.) were passed for further use. The governor fuel-pressure switch and acceleration control required re-calibration. Further design changes have been incorporated in these units which will eliminate the tendency to shift. The tailpipe thermocouple, ignition lead and altitude compensation bellows required replacement.

To the surprise of the manufacturers, the stainless-steel housing for the generator set showed signs of extensive wear, but this would not, of course, influence engine performance.

Commenting on the satisfactory reliability of their small gas-turbine, Solar state that the condition of the components was mainly due to the conservatively low design-temperatures for the turbine inlet, namely, 1,100 deg F, 593 deg C (rated). The duties of an A.P.U. call especially for simplicity and reliability.

"FLIGHT" PHOTOGRAPHS

MANY of the photographs reproduced in *Flight*, i.e., those taken by our own photographic staff (as indicated on publication) are subsequently available in the form of high-quality prints. Prices are as follows (dimensions given in inches): $5\frac{1}{2} \times 3\frac{1}{2}$, 1s 4d (glossy or semi-matt, unmounted) or 2s (toned sepia, unmounted); 6×4, 2s 6d or 4s; 8×6, 3s 6d or 5s 6d; 10×8, 5s or 7s 10d; 12×10, 6s or 9s 8d; 15×12, 9s 6d or 13s; 20×16 (semi-matt only), 13s or 18s.

Also available are a postcard series, totalling over 200, depicting both historic and modern aircraft of the R.F.C., R.N.A.S., R.A.F. and Fleet Air Arm. Complete lists of the series are obtainable on application. Prices are 8d each card, or $7\frac{1}{2}$d each for quantities of a dozen or more. One view only—in most cases a good three-quarter front or side—is available for each aircraft type. Also available as postcards, at the same prices, are reproductions of general-arrangement drawings of some 20 British aircraft that have appeared in our "Aircraft Intelligence" pages

CAREERS IN THE DRAWING OFFICE

IN its "Choice of Careers" series of publications, the Central Youth Employment Executive has published a new booklet, *Engineering Draughtsman*,* dealing in turn with each of the principal engineering industries employing draughtsmen. The booklet is most informative; two pages are devoted to the specialized requirements of the aircraft industry, opening with the statement that "The most striking feature of draughtsmanship in aeronautical engineering is that of size: an aircraft drawing-office is often a large building in which several hundred men are at work, for such a staff is necessary to deal with the large number of drawings to be made—possibly 20,000 for an airliner, representing half a million man-hours. The volume of work also affects its speed and character; working prints are often made from the draughtsman's original sheets before they are traced, so that his line work must be particularly clean and bold."

**Price 1s, Her Majesty's Stationery Office.*

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Seen by a Berlin Spotter

IT may be worth mentioning something about Russian aircraft in the Soviet Zone of Germany, in reference to the photograph of the "long range Migs" (*Flight*, November 12th, 1954).

Though living in the northern part of Berlin I have never seen one of these aircraft. But I have seen bombers of the Il-28 type, and when you see the Il-28 from behind it looks rather like a Mig-15 with underslung tanks—with the similar tailplane and rudder assembly and especially with the long, podded engines.

The Il-28 was seen in two versions over Berlin. Until 1952 there was a short-nosed (as compared to the newer version) type with shorter engines; then we saw only the new version. It is possible that we saw the bombers until 1952 and now see the trainers only. A friend of mine saw an Il-28 with tip tanks over the Magdeburg area. During the summer—especially in May and August—we saw lots of Il-28s passing over in formations of four; one Sunday morning there were 36.

As for Mig-15s I saw the first in 1950, flying along the northern outline of Tegel airport. The aircraft was flying at about 1,500-2,000ft and was going very fast. In 1953 I saw about four or five flying singly at between 3,500 and 1,800ft. I never saw more than one Mig-15 over Berlin.

In 1954 I saw only two Migs, both flying very high over Berlin; but when going to Western Germany in October I saw, between Madgeburg and Helmstedt, two Migs with wing-tip tanks and four of the type illustrated in the above-mentioned issue.

Other Russian aircraft noticed were the Po-2 and Pe-2; these types have been stationed since 1951 on Legebruch airfield, near Oranienburg.

Berlin. K. FE.

TV's Air War

EVERYONE seems very disappointed at the anti-climax to months of advance publicity for the television series *War in the Air*. After hearing many comments to the effect that it might just as well be called *War on the Ground* I timed the sequences which really had something to do with the air forces in No. 9 of the series, *Wings Over Italy*. Including shots of the U.S.A.F. they occupied just on ten minutes. The remaining twenty minutes were taken up by the opening and closing sequences, ground activity at Cassino, P.O.W.s being marched away, factory machinery, goats, fishing boats, amphibians landing on the beaches, and, as the commentator explained, "troops moving on over the brown dust."

"War in the air," so far as TV viewers are concerned, is depicted usually by anonymous thumbs pressing gun-buttons, fighter aircraft blowing up, and bomb-bay doors either opening or closing. Air strategy, control, and general operational tactics have been mostly ignored.

When the Pathfinder Association first suggested *War in the Air* to the Air Ministry, they had in mind a feature film of up to two hours. But the B.B.C. evidently wished to copy the American *Victory at Sea* with a long and "bitty" series. Let us hope the remaining half-dozen or so half-hours do something to make up for the disappointing start.

London, W.1. G. A. THORNE.

WITH reference to your critic's summary of TV's *War in the Air*, Episode 7 (*Flight*, January 1st, 1955), the machine stated to be a Pete was surely a Dave (Nakajima Navy 95). In the rear view shown, the multiplicity of bracing wires connecting the central float with the fuselage was conspicuous.

Droitwich. BRYAN WILKES.

"Blind-Flying" Passengers?

FOLLOWING on the evidence given at the Comet Inquiry, upon which we may not comment, one fact emerges, which is: if high-altitude aircraft are to be made safer in the light of present knowledge, cabin windows and such superfluous cut-outs in the cabin will have to go. I see no reason for their presence other than that of passenger reaction.

For myself, on the occasions when I have travelled by air, I have spent most of the time between take-off and touch-down asleep, and have had no interest in the (non-existent) view at all.

If people insist on high-speed travel, then, like those who go by the London Tube, they will have to forgo their view of the scenery. And if they object, I think a number of tastefully painted dummy windows would serve almost as well.

Surbiton, Surrey. J. V. SMITH.

IN BRIEF

In *Flight*, July 16th, 1954, we reported that a Canadian, Mr. S. N. Green, had built and flown a full-scale Bleriot replica and that he was contemplating construction of a D.H.2. He now tells us that he is having difficulty in obtaining constructional details, for the latter aircraft, and he would be grateful to any readers who could assist him; he would also find structural details of the Sopwith Pup of interest. His address is: Aero Department, Provincial Institute of Technology and Art, Education Building, 13th Ave. and 10th Street N.W., Calgary, Alberta, Canada.

FORTHCOMING EVENTS

Jan. 22. British Interplanetary Society (provisional Yorkshire branch): Short-paper evening.
Jan. 22. British Interplanetary Society (provisional Western branch): "Engineering Problems in the Construction of Satellite Vehicles," by G. L. Garthwaite.
Jan. 24-28. Institute of the Aeronautical Sciences: 23rd Annual Meeting and Honors Night dinner, New York.
Jan. 25. British Interplanetary Society (provisional Scottish branch): Brains trust.
Jan. 25. R.Ae.C.: Film show.
Jan. 25. R.Ae.S. Graduates' and Students' Section lecture: "Test-flying a V-bomber," by S/L. H. G. Hazeldon, D.F.C. and Bar, and R. H. Williams, B.Sc., A.F.R.Ae.S.
Jan. 26. R.Ae.C.: Dinner to 1954 British Air Racing Champion and winner of King's Cup Air Race.
Jan. 27. R.Ae.S. Section lecture: "Dynamic Problems of Interplanetary Flight," by D. F. Lawden, M.A.
Feb. 1. Institute of Transport: Informal luncheon.
Feb. 2. Royal United Service Institution: "The Greenland Expedition," by Cdr. (L) C. J. W. Simpson, D.S.C., R.N.
Feb. 2. Woman's Engineering Society: "The Work of the British Standards Institution," by L. G. Watkins.
Feb. 3. British Interplanetary Society: "The Development of the Snarler Rocket Motor," by D. Hurdon, B.A., Grad.I.Mech.E.
Feb. 5. British Interplanetary Society (Midlands branch): "The Atmosphere and Space-ship Design," by A. H. Wickens, B.Sc., D.I.C., Grad.R.Ae.S.
Feb. 8. R.Ae.S. Section lecture: "Some Trends in the Development of Aircraft Electrical and Starting Systems," by R. H. Woodall, F.R.Ae.S.
Feb. 10. R.Ae.S. Main lecture: "Problems and Prospects of Rocket Propulsion for Aircraft," by Prof. A. D. Baxter, M.Eng., F.R.Ae.S. (at I.O.W.).
Feb. 11. Helicopter Association: "Development Experiences with the Bristol Type 173," by R. Hafner, F.R.Ae.S.
Feb. 14. Institute of Transport: Brancker Memorial Lecture: "Influence on Civil Aviation of Some Current Researches," by Sir Arnold Hall, F.R.S.
Feb. 16. Institute of Metals: Informal discussion on "The Treatment of Swarfs, Sawings and Residues in the Non-Ferrous Metal Industries" (at Birmingham University).
Feb. 17. R.Ae.S. Section lecture: "Problems Associated with Stress Concentration," by H. L. Cox, M.A., F.R.Ae.S.
Feb. 18. Institute of Navigation: "Automatic Dead Reckoning Instruments," by H. C. Pritchard.
Feb. 18. A.T.A. Association: Reunion dinner.
Feb. 19. British Interplanetary Society (provisional Yorkshire branch): Film Show.
Feb. 22. R.Ae.C. Film Show.
Feb. 23. Royal United Service Institution: "Rocket Propulsion and its Implications to Human Society," by A. V. Cleaver, F.R.Ae.S.
Mar. 1. R.Ae.S. Section lecture: "The Scientific Approach and Research in Aircraft Production," by Prof. J. V. Connolly, B.Eng., F.R.Ae.S.
Mar. 9. Royal United Service Institution: "Long-distance High-speed Flying," by W/C. L. M. Hodges, D.S.O., O.B.E., D.F.C.
Mar. 10. R.Ae.S. Main lecture: "Structural Safety," by Prof. A. G. Pugsley, O.B.E., D.Sc., F.R.Ae.S. (at Preston).
Mar. 11. Helicopter Association: "Helicopter Maintenance," by J. H. Willins, A.M.I.C.E.
June 4-5. Royal Air Forces Association: Annual Conference.
June 10-19. Paris Aero Show.

R.Ae.S. Branch Fixtures (to Feb. 16):—

Jan. 24, *Henlow*, "The Large Transport Helicopter—its Design Problems," by Dr. G. S. Hislop. Jan. 25, *Belfast*, "The Helicopter—has it a Future?" by F. H. Robertson. Jan. 26, *Preston*, "Domain of the Helicopter," by R. Hafner; *Weybridge*, "Fuels and Lubricants for Aviation," by Dr. C. B. Davies. Jan. 27, *Yeovil*, "History of Helicopter Patents," by L. H. Hayward.

Jan. 31, *Halton*, Junior Members' night.

Feb. 2, *Chester*, "Global Winds and Weather," by C. S. Durst; *Brough*, "Air Accidents," by A. Cdre. Vernon Brown; *Luton*, "Controls and Stability," by J. Wimpenny; *Southampton*, "The Lightweight Jet Engine," by Dr. S. G. Hooker. Feb. 3, *Cheltenham* (area lecture: Coventry, Birmingham, Gloucester and Cheltenham branches), "Comparisons of Some Aircraft Propulsion Systems," by Prof. A. D. Baxter.

Feb. 7, *Belfast*, "Rocket Motors," by D. G. Kennedy; Feb. 8, *Boscombe Down*, film evening. Feb. 10, *I.O.W.*, main lecture (see above).

Feb. 16, *Manchester*, "The Scientific Approach to Production Problems," by Prof. J. V. Connolly.

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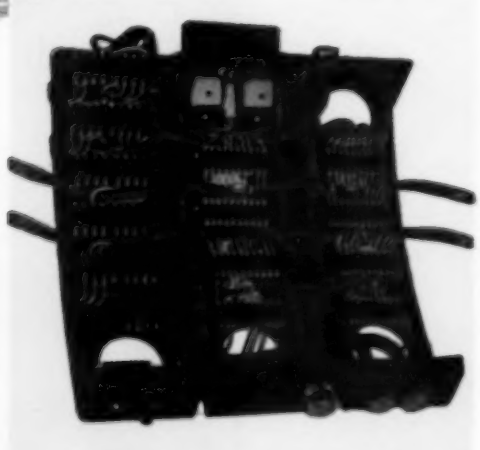

Electrical Supply Panel—Hawker "Hunter". A typical example of preformed wiring employing Plessey components. (Photographed by courtesy: Hawker Aircraft Ltd.)

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A 31

CIVIL AVIATION

"Flight" photograph

The stage reached last week in Britannia 100 production at Filton is shown in this new picture of the main assembly hall. In the foreground is the seventh production machine, with the ninth and eighth on its left; Nos. 6 and 3 are on the far side of the hall, with No. 5 at right centre and the port wing of the fourth aircraft on extreme right.

DC-7Cs: DOUGLAS STATEMENT

LAST week the Douglas Aircraft Co. issued a brief comment on recent reports of B.O.A.C. interest in the DC-7C non-stop transatlantic airliner. Mr. Nat Paschall, the company's vice-president (commercial sales), said that for the past few months Douglas had been discussing with British Overseas Airways Corporation and with several other international carriers the "advantages, availability and early delivery dates" of their latest commercial transport, the Seven-Seas model Douglas DC-7C. Considerable progress had been made in these negotiations. Mr. Paschall added: "Formal announcement, if any are made, of the results of our discussions undoubtedly will be made by the purchasing airline or the government officials involved in the proposed transactions."

Douglas say that the prototype DC-7C is expected to fly by December 1955, and that the first delivery, to P.A.A., will be made by the spring of 1956.

IDLEWILD APPROACH LIGHTS CRITICIZED

COMMENTING on the accident to an L.A.I. DC-6B at New York International (Idlewild) Airport on December 18th, the New York *World Telegram* has suggested that the airport's system of approach lights was a contributory factor. According to an agency report, the paper states that pilots using Idlewild have described the lights as dangerous and obsolete, causing misjudgement of position. The lights are of the "slope-line" pattern, employing converging double rows of lights leading into the runway threshold.

SINO-SOVIET AIR PACT

THE signing of a bilateral air agreement between the Soviet Union and the Chinese People's Republic was reported on December 30th. The agreement provides for the operation of reciprocal air services between Russian and Chinese cities by aircraft of both countries. It was also announced that from January 1st Russia would transfer to China all her shares and property, including aircraft, in the Sino-Soviet Civil Airlines. The agreement was signed in Pekin by Air Marshal Zhavoronkov, chief of Aeroflot, on behalf of Russia. At a reception given in honour of the agreement it was stated that Chinese civil aviation had been progressing rapidly in recent years, and that Chinese aircraft would soon be appearing regularly at the airports of foreign capitals.

U.S. AIRLINE FINANCES: A SURVEY

JUST released for sale on both sides of the Atlantic is an independent financial survey* by a Washington, D.C., firm of aviation consultants, Henry Beecken and Associates. The survey is in three parts, dealing with (a) the U.S. domestic trunk airline industry; (b) American Airlines; and (c) Capital Airlines.

Mr. Beecken, whose experience includes 14 years as a security analyst for New York stock firms, five as an airline official and seven as consultant to a number of airlines, writes in a foreword that he has long felt a need for a better understanding of the airline industry by financial institutions and investors: hence the survey of the domestic trunk line group. American Airlines were chosen for special study as the largest and strongest airline, and Capital Airlines were singled out as an interesting "investment situation" and, potentially, an "excellent speculative opportunity". The survey itself, incidentally, is something of an investment situation, since it is priced at £8 per copy. The third part of the Beecken study is of great topical interest in both the United States and Britain, in view of Capital Airlines' recent order for 60 Viscounts. Why did Capital, rather than any other American carrier, decide to buy Viscounts? What financial arrangements have been made to cover the purchase? What truth is there in suggestions that Capital have "gone overboard" in ordering so many new aircraft? The report sets out to answer these and other questions asked since the announcement of the Capital order.

During the 1945-46 expansion period, says the Beecken survey, Capital Airlines over-estimated their personnel requirements; in 1946 the company lost $3m and re-equipment plans had to be cancelled. The airline weathered the lean years of 1946-48, expanded its traffic and eliminated its dependence on mail subsidy. During the 12 months ended June 30th, 1954, Capital carried 2¼m passengers, a total exceeded only by American, United, Trans-World and Eastern. Due to their early post-war setbacks, however, Capital had never succeeded in re-equipping on the same scale as their competitors (their fleet consisted, on September 30th last, of 22 DC-3s, 25 DC-4s, seven Constellation 749s and five Constellation 049s). Since the bulk of this fleet was obsolescent and written off the books, Capital were able to move a step ahead of their competitors by ordering Viscounts. The order for 40 Viscounts was signed last August, and an option for a further 20 was taken up in December.

Capital's analysis of the Viscount showed that, carrying 48 passengers and utilized for 8.5 hr daily, the aircraft would break even at a 52 per cent passenger load factor. This estimate assumed an average yield of 5.8 cents per revenue passenger-mile, which is the figure actually achieved on Capital's existing routes. In the 12-month period ended June 30th last, Capital's load factor was 57.58 per cent. European experience with the Viscount bears out Capital's belief that its strong competitive appeal will bring increased load factors, by creating new traffic and by diverting traffic from competitors. Capital's stages are short (averaging some 300 miles), and the airline expects the Viscount to offer an average block speed of 240 m.p.h., or 33 per cent more than the average attained with present equipment.

Originally Capital planned to replace their entire fleet with Viscounts. There are now indications, say the Beecken report, that some DC-3s will be retained for service on the least dense routes, as well as some Constellation 049s for coach services. Delivery of all 60 Viscounts will not be completed before February 1957, but even allowing for a continuation of today's growing traffic, it could be inferred that Capital are taking an over-optimistic view of the fleet capacity which they will require in two to three years' time. Sixty Viscounts alone are capable of producing over 2,000m seat-miles annually, whereas the company operated less than 1,250m seat-miles in 1953-54.

The Beecken survey concludes that Capital Airlines stand to gain by their Viscount order regardless of whether they will require their total planned capacity by 1957-58. The extent of extra traffic to be generated by the Viscounts cannot be determined now, and—the argument runs—the past record shows that it is better to have too many aircraft than too few: "The carrier with the equipment available is the one that gets the business." Furthermore, Capital have applied to the C.A.B. for changes in their route structure—changes which would bring a need for

**A comprehensive Financial Study of the Domestic Trunk Line Industry, and of American Airlines, Inc., and Capital Airlines, Inc. Price, £8. Published by Henry Beecken and Associates, 1333 G Street, N.W., Washington, D.C., U.S.A.*

The first German-registered aircraft of post-war design are the four Convair 340s of Lufthansa, whose operating plans are outlined below. Lufthansa's styling, illustrated here on one of the Convairs, includes a white top, blue fuselage flash and gold lettering.

CIVIL AVIATION . . .

greatly increased seat-mile capacity. Finally, it is pointed out that the airline has virtually cornered the Viscount market for some time to come, and that Capital's contract with Vickers-Armstrongs does not include the usual U.S. manufacturer's clause controlling re-sale of the aircraft.

Unusually favourable financing arrangements, the survey points out, were involved in the Capital order. No down payments are to be made by the airline, which will begin to amortize the debt on each aircraft on a 60-month basis immediately after delivery. Interest on the unamortized balance has been set at the Bank of England's re-discount rate plus 1.75 per cent—a total interest rate of 4.75 per cent. Total cost to Capital of the 60 Viscounts is quoted at $67m (£24m). Engine and airframe spares stocks valued at $15m will be maintained by Rolls-Royce and Vickers-Armstrongs at Montreal and Alexandria, Virginia, respectively.

GERMAN REVIVAL

LONDON'S importance as a centre of air traffic is reflected in the plan announced by the new Deutsche Lufthansa, Germany's post-war national airline, for the opening of its European network in April. It is the airline's intention to operate two return services daily between Germany and London—one through Hamburg and Dusseldorf and the other through Munich and Frankfurt.

Lufthansa will also operate three return services weekly on the Hamburg-Frankfurt-Paris route. There will also be two round trips weekly between Hamburg, Cologne, Frankfurt and Madrid. These services will be operated with Convair 340s, based at Hamburg, where new maintenance buildings are under construction. Four of these aircraft were ordered, and the first deliveries have already been made.

For their long-haul services, D.L.H. have ordered four Super Constellations, with delivery of the first due in mid-March. An order for four more Super Constellations is reported to be under discussion. The airline hopes to introduce these aircraft to services on the North Atlantic route in June or July, operating six return flights weekly between Hamburg and New York. Three of these flights will operate *via* Dusseldorf and three *via* Frankfurt, and there will presumably be an intermediate stop at Shannon or Prestwick.

Though Lufthansa will have to face strong competition from airlines already long-established on the North Atlantic route, there is already a substantial flow of passenger traffic originating in Germany, which, it is thought, could be diverted to the German airline. It has been estimated that seven per cent of the passengers who flew the Atlantic last year were of German nationality.

Sixteen pilots, many of them captains in the pre-war Lufthansa and all with at least 2,000 hours' flying experience, are under training for the new airline. Initially they will fly as first officers to captains seconded from B.E.A. (see photograph below). Also under training are sixteen stewardesses.

WRONG RUNWAY

THE captain and one passenger were injured when B.E.A. Viscount G-AMOK *Sir Humphrey Gilbert* hit a series of obstacles at London Airport on Sunday, January 15th, while leaving for Rome and Athens. The aircraft should have taken-off from runway 15R, which runs from the N.W. corner of the airport in a south-easterly direction. In poor visibility, however, the Viscount turned off the taxi track some 400 yd short of runway 15R and attempted to take-off from the disused stub of runway No. 3, which was part of the original pattern of the airport. There were apparently no markings to show that this runway, which is parallel to 15R, is no longer in use.

During its run the aircraft struck a barrier of steel girders, which tore off the two port engines and part of the undercarriage. Though some of the Viscount's fuel tanks were ruptured the aircraft did not catch fire—a point which bears out claims for the relative safety of kerosine fuel in such an accident. Of the 25 passengers aboard the aircraft, 22 flew to Rome later in a relief aircraft. In command of the Viscount was Capt. E. J. Waits.

The Ministry of Transport and Civil Aviation announced on Monday that the Chief Inspector of Accidents was carrying out a preliminary investigation into the mishap, and that he would make an advance report to the Minister.

BREVITIES

SABENA have placed an order in the United States for two Sikorsky S-55 helicopters, to be delivered next month. Four of these aircraft are already operated by Sabena on their international network of passenger helicopter services.

* * *

The number of Saab Scandias in service with S.A.S. was recently increased to ten by the delivery of two new aircraft built under licence in Amsterdam by Fokker.

* * *

The French Thomson-Houston Company has supplied a surveillance radar for Paris-Orly airport to provide traffic control for the Northern French Control Region. Claimed to be the most advanced of its kind in Europe, the new installation has a range of up to 40,000ft and 95 miles.

* * *

The experimental Whiting Loadair system (described in *Flight* of December 17th, 1954) installed at New York International Airport is now in operation. Further application of the system, which mechanically parks an aircraft in relation to a permanent loading dock, depends on the results of a twelve-month trial.

* * *

India and the United States have been unable to settle the terms of a new bilateral agreement to replace that which expired on January 14th. Pending the signing of a new agreement,

Portrayed are eight of the ten B.E.A. pilots seconded to Deutsche Lufthansa (left to right): Capts. J. Monro, S. J. Brown, P. C. Ward, P. R. Griffin, K. T. Quirke, D. H. Symington, J. G. Simpson and A. R. Marks. After conversion training on Convair 340s, which should be completed by April, the B.E.A. pilots, wearing D.L.H. uniform, will captain these aircraft on scheduled services for the following year.

P.A.W.A. and T.W.A. are being granted temporary permits to pick up and set down passengers at Indian airports. The combined frequency of services through India by these two airlines has been reduced from six to four weekly.

Airwork, Ltd., have appointed the Blue Star Line, Ltd., and Furness Withy, Ltd., as U.S. general sales agents for their new all-freight service, Airwork Atlantic, which is due to start on March 1st. Sir Archibald Hope (seated, right), Airwork's joint managing director, is seen signing the letters of appointment, with Mr. John E. Muhlfeld, president of the American company Airwork Atlantic, on his right.

CLUB AND GLIDING NEWS

STATISTICS recently announced by the Aircraft Owners and Pilots' Association give a revealing picture of private-flying activity in the U.S.A. Private owners fly almost as many multi-engined aircraft (1,411) as the scheduled airlines (1,477). In addition to these private owners, business organizations own 2,437 multi-engined types. In the single-engine field, 63,464 machines are privately owned and 19,063 belong to businesses. At C.A.A.-controlled airports (which represent only three per cent of the U.S. total), 7,755,500 non-airline civil aircraft movements were logged in one recent year, compared with 5,482,515 movements for the airlines.

In an editorial in the December issue of the *AOPA Pilot*, it is also pointed out that the 10,487 civil aircraft currently registered in California alone come very near to equalling the combined total (11,581) of civil aircraft registered in 21 other countries throughout the world. Even more illuminating is the comment that "all the 634 private aircraft in the British Isles add up to just 58 planes more than are registered in the tiny District of Columbia —which, incidentally, doesn't even have an airport."

[The Register of British Civil Aircraft for January gives the "Business and private" aircraft total as only 474 (378 possessing current certificates of airworthiness), giving the District of Columbia a clear lead.]

LASHAM, for the first time, is to be the site of this year's National Gliding Championships, which are to begin at 3 p.m. on July 23rd, continuing until August 1st. Final permission having been given by the Air Ministry (who still own the airfield), the Surrey Gliding Club group are now going ahead with their plans for organizing the meeting. The Lasham site is flat and, with no convenient ridge along which the competitors can soar while awaiting good "going-away" thermal conditions, special problems are posed. Subject to sufficient aircraft tugs being available—help in this from other gliding clubs and flying clubs will be welcome—launches are to be by aero-tow in both single-seater and two-seater classes. Competitors and volunteer helpers will be accommodated in caravans and tents, and special site arrangements are being made to accommodate up to 100,000 spectators. Plans for entering several R.A.F. teams—the strongest Service entry for some years—are to be discussed at the annual meeting of the R.A.F. Gliding and Soaring Association today.

OVER the Sierra Nevada mountains at Bishop, California, on January 9th, Cdr. H. C. N. ("Nick") Goodhart, R.N., reached a height of 30,500ft above sea level in a Schweizer 1-23 sailplane. Although this altitude is the greatest yet attained by a British sailplane pilot, it is not recognized as a new national record as it does not exceed by five per cent the previous record (30,000ft, set up by Philip Wills in New Zealand on December 29th). Goodhart released from an aero-tow at 10,900ft, and climbed in a lee-wave from the Sierra Nevada range. One of the famed Bishop waves was also responsible for the present world altitude record for single-seat sailplanes of 42,100ft, set up by W. S. Ivans, the American pilot whose machine, incidentally, was used by Goodhart on his more recent flight.

FIFTEEN new members joined the Surrey Flying Club during December, bringing the total strength to nearly 200, compared with 75 in May when operations began at Croydon. By the end of last year, 1,005 flying hours had been logged (December's total amounting to 58), and New Year's Day was celebrated by a first solo by Mr. Kenneth Smith. Foundations for the new club-house have now been dug, and it is hoped that the building, of prefabricated type, will be ready for erection this coming week-end. During December Miss Freydis Leaf flew the club's Hornet Moth to Deauville and back.

PREVIOUSLY C.F.I. to the Reserve Flying School at Redhill, S/L. E. P. Lash, A.F.C., now C.F.I./manager of the Kuwait Flying Club, reports that the first eight Kuwaiti pupils of the club have now qualified for their British licences. The Kuwait club is operated by His Excellency Sheik Abdulla Al Mubarak Al Subah and, after the delivery of four new aircraft, will have a fleet of three Auster Autocars and five Aiglets.

HOGMANAY was celebrated with a successful turkey dinner by the Strathtay Aero Club. The extremely poor flying weather at Perth during December was reflected in the month's total of only 32 hours, one-third of which was flown on one Sunday. For the current year, Mr. W. H. Byars has succeeded Mr. R. B. Henderson as chairman, Sir John Ure Primrose continues as president, and Mr. George McLean and Mr. A. M. Mackay have been reappointed vice-chairman and secretary-treasurer respectively. Mr. James Clark is a new committee-member.

R.Ae.C. PILOTS' CERTIFICATES, OCTOBER-DECEMBER, 1954

No.	Name	Cl.	Date	No.	Name	Cl.	Date
28,628	R. E. Gamble ...	2	4/10	28,639	B. C. Martin	3	16/11
28,629	K. A. Fewkes	2	7/10	28,640	C. J. Palmer	1	17/11
28,630	R. F. Fowler	4	12/10	28,641	H. MacA. Carnegie	3	18/11
28,631	R. J. Parkhouse	2	12/10				
28,632	W. R. Parkhouse	1	12/10	28,642	L. R. Massey	4	24/11
28,633	J. W. Crouch	3	15/10	28,643	R. J. Linford	1	29/11
28,634	S. Z. Ahmed	4	20/10	28,644	H. van Gorkum	2	30/11
28,635	D. F. Sykes	1	26/10	28,645	W. C. Hammond-Adler	1	1/12
28,636	D. Sturgeon	3	28/10				
28,637	R. D. Stebbings	2	11/11	28,646	P. V. Bourke	2	17/12
28,638	A. J. Jackson	2	16/11	28,647	J. E. F. Crossley	4	23/12

LONDON AIRPORT CENTRAL . . . (Continued from page 72)

On the groundside, the first-floor concourse widens at this central region (between channels six and seven) to accommodate shops, buffet, post-office and nurseries.

A central ground-floor entrance hall, separate from the series of entrances to the individual channels, is intended for passengers and others arriving by their own transport, and for luggage in advance. It is the wing to the right of this—the southwest end of the building, housing four continental channels and the two internal channels—on which work will continue until the completion of the building in September.

Much construction work is taking place at present on the air-side or "apron-side" of the building, where the three double-ended ramps jut out from the body of the building down to the apron. When complete, the central restaurant section will have an open beer-garden on one side and—the key to the official plans reveals —a "roof garden (waving base)" on the other. This apparently refers not to an undulation of the floor but to the function of friends and relations of embarking or arriving passengers. Several other roof-terraces for spectators are provided; the spectators' roof-level bridge can be seen in construction, connecting with the terrace on the eastern apex building, and there is a first-floor bridge joining the passengers' galleries of the two blocks.

The eastern apex building, otherwise known as the airline operation building, is scheduled for completion in about a year's time. Its purpose will combine the handling of aircraft operations (including aircraft and crew clearance, load control, meteorological forecasting, flight planning and crew briefing) with the provision of amenities for the general public, such as an exhibition hall, post office, news cinema, grill room and buffet.

Eventually the memorial to Alcock and Whitten-Brown, now at the western end of the northside apron, will be placed opposite the public entrance to this block. The appearance of the building at present is simply that of a complicated steel framework, but the recollection of the recent marked progress made on the other two buildings adds weight to the thought that this first trio of central-area buildings will be fully operational a year from now.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Here and at the foot of the page are two of the first air-to-air photographs of No. 101 Squadron's new B.6 Canberras, four of which they are shortly taking to Singapore for three months.

New Canberras for Malaya

FOUR of a recent version of the Canberra are to spend three months undergoing operational trials with the Far East Air Force. They are B.6s of the No. 101 Squadron (S/L. W. D. Robertson), and are expected to leave on February 7th.

The Canberra B.6 is more powerful and has greater range than the B.2, which it is superseding in some of the bomber squadrons. No. 101 Squadron, which was the first to receive the original B.2s towards the end of 1951, was also the first unit to have the B.6.

The four Canberras will fly by way of Idris (Libya), Habbaniya (Iraq), Mauripur (Pakistan) and Negombo (Ceylon) to Tengah, Singapore, which will be their base. They will undertake a comprehensive series of operational trials in the hot and humid climate of Malaya, and special study will be made of such characteristics as take-off and general handling performance, and the behaviour of the electrical and other installations in the aircraft. Aspects affecting the crews physiologically will also be studied, including the performance of the cockpit cooling system and the new air-ventilated flying clothing.

This will be the first time that R.A.F. jet bombers have been based in the Far East. A Bomber Command staff officer will accompany the detachment, and in addition to the 18 aircrew members—crews for the four aircraft, plus two reserve crews—a ground servicing party of 50, headed by an engineer officer and an equipment officer, will also go to Malaya. The ground party and the reserve crews will fly in two Hastings of Transport Command.

R.A.N. To Train Own Airmen

THE Royal Australian Navy will in future train its own Fleet Air Arm observers and aircrew, the Australian Minister for the Navy, Mr. J. Francis, reported recently. The training will take place at the naval air station at Nowra, New South Wales, and is to be conducted on lines similar to those of the Royal Navy and Royal Canadian Navy. Until now, Australia's Fleet Air Arm observers and aircrew have been trained with the Royal Navy in Britain.

The first observer trainees will enter the Nowra school in February. They will be officers and ratings who have transferred to the Fleet Air Arm, together with a few entrants from civilian life. The observers will fly in de Havilland Sea Venoms and Fairey Gannets.

The Gannets will be brought from England in the new aircraft carrier *Melbourne* at the end of this year.

Australia, incidentally, will have only one aircraft carrier on active duty for most of the year. H.M.A.S. *Sydney* will cease flying operations to become a training ship at the end of April. H.M.A.S. *Vengeance*, which has been on training duties, will at the same time start preparations at the time for her return to England.

Two Shackletons Lost

DESPITE a long and careful search in the area in which they were lost, up to last week-end there had been no further trace of the two Shackletons from St. Eval, Cornwall, which had been missing since Tuesday 11th. They were last heard of 50 miles south-west of Fastnet Rock. Bad weather interfered with the search operations.

The two crews were: F/Os. G. Board, K. G. Richards, G. Rogers, B. H. Webb, N. Horrocks, C. Molyneux, P/O. L. W. Woods, M/Sig. I. O. Cathcart, F/Sgt. M. G. Rae and Sgts. J. Goodwin, L. R. Swann, E. J. Morgan, G. Thompson, H. Davies, D. Male, R. E. Ridgers, L. W. Cooper and C. W. Scott.

Fighter O.C.U. Formed

IN New Zealand operational training of fighter/ground attack pilots is now to be performed by a fighter operational conversion unit at R.N.Z.A.F. Station, Ohakea. The unit will be responsible for conversion of fighter/ground attack pilots to jet aircraft, their initial operational training, their instrument rating on jet aircraft, and their jet familiarization as required.

This task was formerly undertaken by No. 75 Sqn., which, in the interests of efficiency, has been relieved of the responsibility for initial operational training.

A. Cdre. Langdon Retires

A FAREWELL guest-night was held at Andover on January 5th in honour of A. Cdre. Langdon, C.B.E., who has retired after 40 years. The function was attended by a large number of senior officers and A. Cdre. D. W. Lane, C.B.E., Commandant of the Staff College, was president.

Reunions

A REUNION of R.A.F. officers and aircrew who fought in Korea is being held at H.Q. Fighter Command, Bentley Priory, Stanmore, Middlesex, on February 5th. The president is G/C. J. E. Johnson, D.S.O., D.F.C. Particulars from F/L. I. L. M. Johnston, H.Q. No. 42 Group, R.A.F. Kidlington, Oxon.

A reunion for all ranks who served in the R.A.F. in Aden and outstations during 1939-45 will be held at the Cock Tavern, Fleet Street, London, E.C.4., on Saturday, February 19th at 6.30 p.m. Details from W. Brackenbury, The Bungalow, 9a, Rowan Road, London, S.W.16.

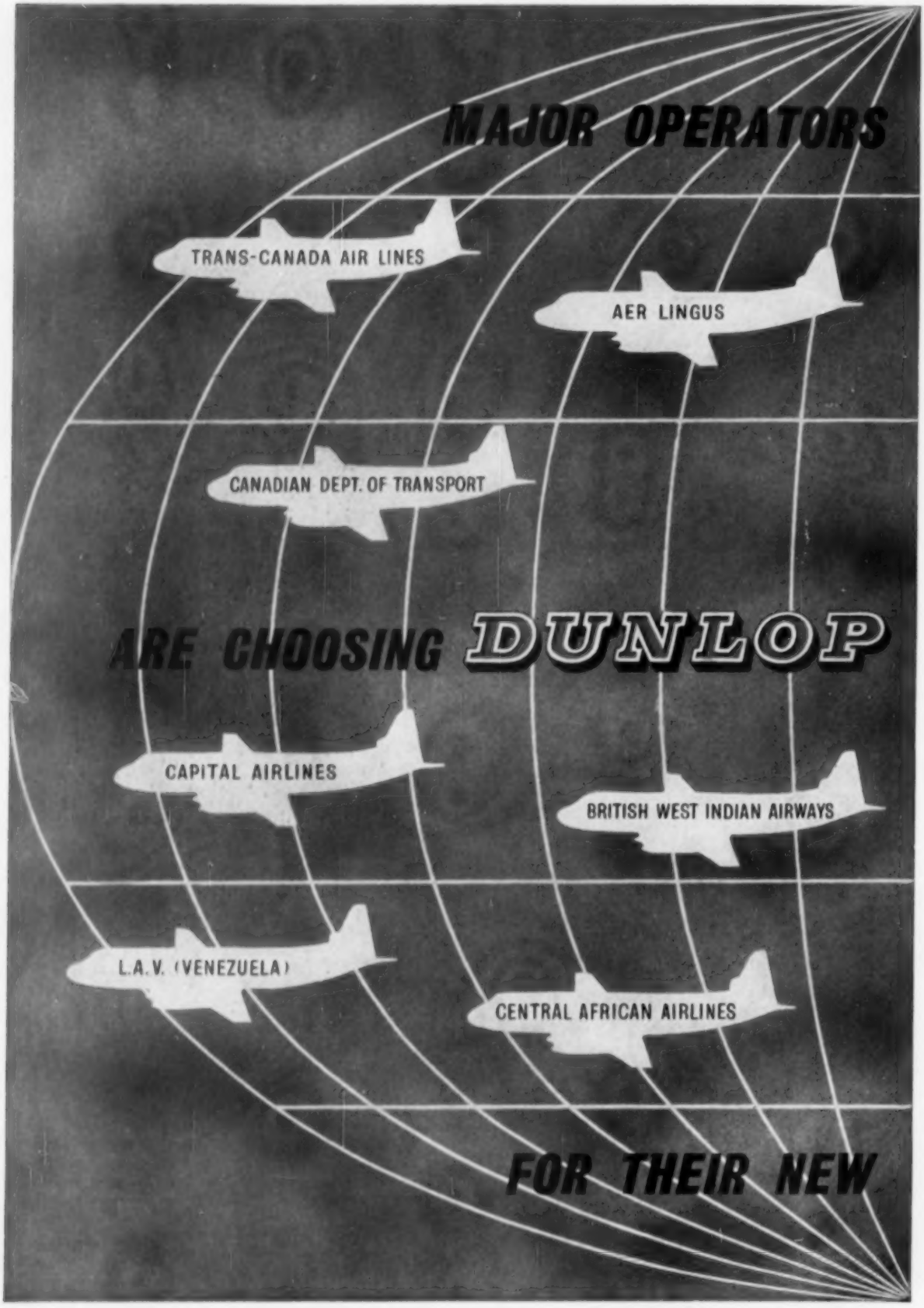
THANK YOU, MRS. WILSON, FOR NEXT YEAR'S AIRLINERS

Keeping Britain ahead in the air by building new airliners is a big job — and calls for a lot of skilled people. But — when you're thanking them all — *please don't forget Mrs. Wilson.* Mrs. Wilson — and nearly 2 million passengers like her — flew BEA last year. Her ticket helps (for example) to put more Viscounts and more Elizabethans in the air. It also helps BEA to send development engineers to advise on the building of the airliners of the future. It's people like Mrs. Wilson who make Britain's civil air supremacy possible.

fly **BEA** *fly British*

IN EUROPE'S FINEST AIR FLEET

BRITISH EUROPEAN AIRWAYS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TRANS-CANADA AIR LINES
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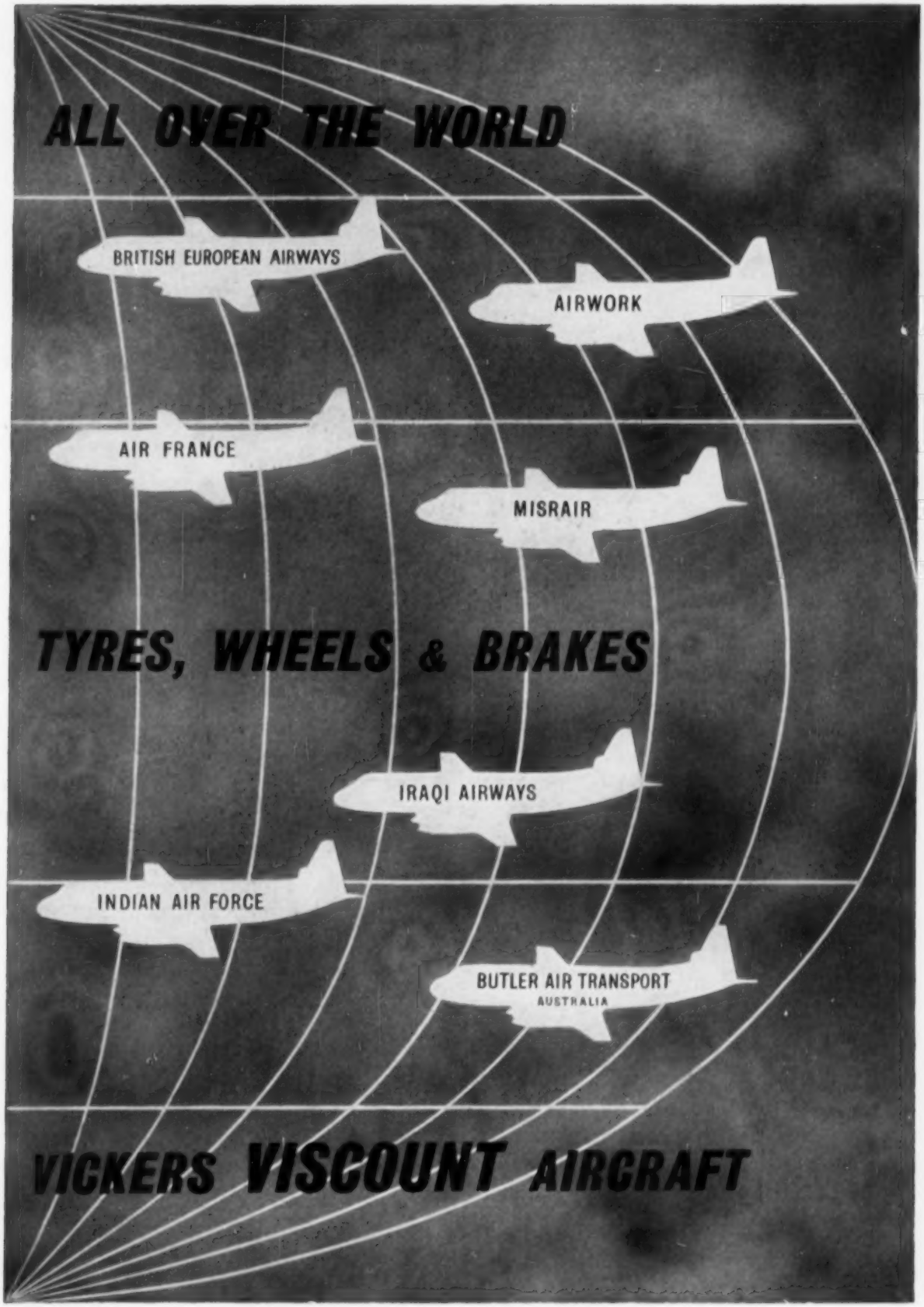
L.A.V. (VENEZUELA)
CENTRAL AFRICAN AIRLINES
FOR THEIR NEW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AIR FRANCE
MISRAIR
TYRES, WHEELS & BRAKES
IRAQI AIRWAYS
INDIAN AIR FORCE
BUTLER AIR TRANSPORT
AUSTRALIA
VICKERS VISCOUNT AIRCRAFT

The D.H. Mk.70 Gipsy Queen Engines
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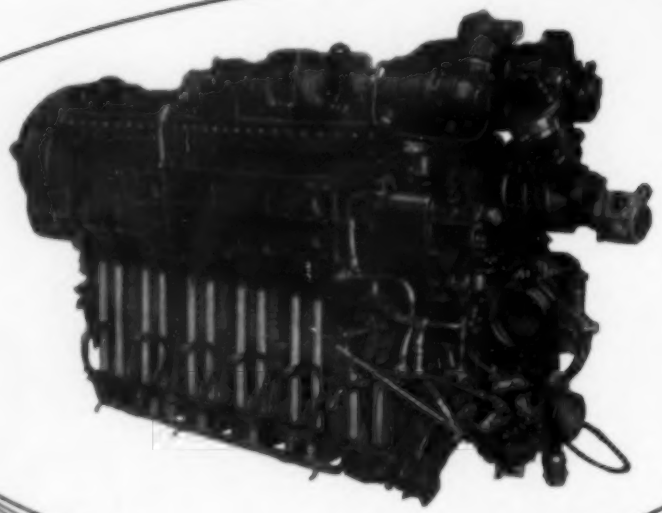
DE HAVILLAND 104 DOVE

DE HAVILLAND



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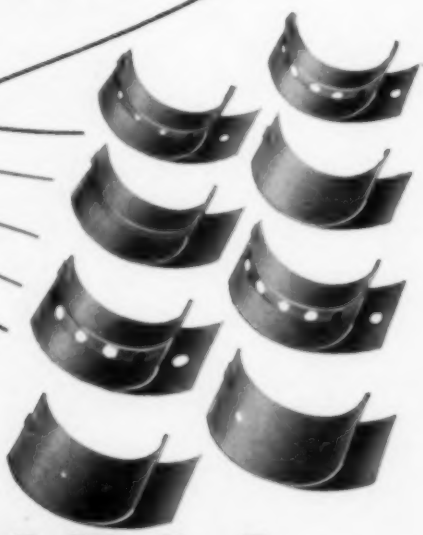

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No. 27 SQUADRON

A Short History of a Famous Bomber Unit

THE presentation, on January 7th, of a Squadron Standard to No. 27 Squadron at Scampton, provided an opportunity to study the history of this remarkable unit. Since its formation at Hounslow on November 5th, 1915, No. 27 has operated in a wide variety of rôles, including reconnaissance, fighting, bombing and transport—few units have been more versatile. In an exciting career it has been wiped out once, disbanded three times and re-formed four times.

The squadron first went to France on active service in March 1916 and was, in fact, only the second unit flying single-seat aircraft to go to France specifically for air fighting duties. It did not remain as such.

The aircraft were Martinsyde Scouts, nicknamed "Elephants," but the origin of this soubriquet is not clear. The machine was larger than contemporary single-seat types, and this may have been the reason, or it may have been considered that there was something elephantine in its outlines.

Comparison of performance with the squadron's 500 m.p.h.-plus Canberras is interesting. The Martinsyde had a 160 h.p. Beardmore engine and a maximum speed of 102 m.p.h.; rate of climb at 10,000ft was 450 ft/min and service ceiling 16,000ft; fully loaded it weighed 2,458 lb. Offensive armament comprised one 0.303

S/L. P. W. Helmore, D.F.C., A.F.C., the present Commanding Officer. "Flight" photographs

Comparative photographs of No. 27 Squadron's present-day silver painted Canberras at Scampton and their olive-green D.H.4 bombers at Serny Aerodrome in France in the latter part of the 1914-18 war.

The Martinsyde Elephant, the single-seater fighter which formed the initial equipment of No. 27 Squadron in 1915.

Mr. Asquith, the then Prime Minister, inspecting one of the squadron's Elephants at Fienvillers, France, during the Battle of the Somme in 1916.

No. 27 SQUADRON . . .

Lewis gun on the top plane, and the total cost of the aircraft was rather less than £2,500.

For its period the Elephant was a rugged and efficient aircraft, though not a good fighter. During the later stages of its use, before re-equipment with D.H.4s, the squadron was more occupied with long-range bombing and reconnaissance.

In command at the time of going abroad was Major A. E. Borton (who, today with the rank of air vice-marshal, made the Standard presentation referred to above). He was still in command three months later when, in preparation for the big Somme offensive, which started in July 1916, the squadron moved up to Fienvillers. Here it formed part of the Ninth Wing, R.F.C., in company with No. 21 Squadron, who were flying R.E.7s and, later, B.E.12s. Oddly enough, this association with No. 21 Squadron is periodically repeated; in the recent war they were together in Malaya and very shortly they will be companions again, when both squadrons of Canberras leave for a month's NATO exercises in the Mediterranean.

To return to the Battle of the Somme. In the preparatory stages the squadron's particular job was to alternate with the Moranes of No. 60 Squadron in flying offensive patrols over the front line in the Arras area.

In the actual battle they were employed largely in bombing enemy communications and airfields and in providing fighter escorts for other bombers. Occasionally they went out on bombing raids and, having disposed of their load, became fighter escorts for other bombers arriving in the area. The arrangement was entirely flexible; sometimes they were escorted themselves by the Sopwiths of No. 70 Squadron and on the odd occasion No. 27 provided not only the bombers but also the fighters to escort them.

The Somme battle was perhaps the first occasion on which British and German air forces fought for definite air supremacy. In this battle No. 27 Sqn found itself part of a force which with great gallantry and determination shouldered the task of beating the Germans despite heavy casualties. That they eventually succeeded is evident from a report by Maj-Gen. Trenchard (now Marshal of the R.A.F. Lord Trenchard) in which he says that our air supremacy was such that during the week under review the German aircraft crossed the Fourth Army lines only 14 times while our own made over 2,000 sorties in the opposite direction.

Many stories of air fighting could be told of that battle; the following, if not typical, shows the spirit of the times. Second-Lt. Usher had been on a bombing raid, the Martinsydes being escorted by No. 70 Squadron's Sopwiths. In an air fight which developed over the target Usher was wounded in the leg and had his main petrol tank badly holed. Deprived of pressure feed, the engine stopped. Usher, however, got his aircraft home; he jammed his knee in the hole in the tank and managed to pump up sufficient pressure to get the engine running again—this at 1,500ft. Usher, who was a well-known rugger player, was to lose his life in a flying accident in 1924.

Although busy over the Somme, the squadron found enough time to make raids on the Zeppelin sheds at Mauberge; these were trips which took over four hours in aircraft with a fuel capacity sufficient for only 4½ hours—even so, a long range for this period.

It was during the Battle of the Somme, too, that a curious occurrence took place, referred to by the German ace Boelcke in his book *Hauptmann Boelcke's Feldberichte*. One patrol of six Martinsydes of No. 27 Squadron were attacked near Bapaume by five biplanes led by Boelcke, who tells how his first victim, after a brief fight, "fell like a sack." He goes on to recount how he then got behind another Martinsyde which tried in vain to shake him off, and how he was surprised, after hitting the British aero-

The squadron relaxes—a high-level horse race in progress at a guest night held in celebration of the recent presentation of the Standard. Left to right: G/C. D. J. P. Lee, Station Commander; S/L. P. W. Helmore, C.O.; Air Marshal Sir George H. Mills, A.O.C.-in-C. Bomber Command; and A.V-M. J. R. Whitley, A.O.C. No. 1 Group. The horses were found to be a good deal more restive than they appear.

"Flight" photograph

A magazine of 18 photographic plates is being handed to a 27 Squadron observer for use in the windmill-driven "L" type aerial camera. This photograph also shows very clearly the armament and layout of the D.H.4.

plane with many bullets at close range, to see it fly round in continuous circles. "I said to myself," writes Boelcke, "the fellow is long since dead, and the machine is flying so because its steering apparatus is fixed in the right position. I flew therefore quite close and saw the occupant leaning over to the right, dead in his cockpit. So that I should know which of the machines I had shot down (surely it must go down), I noted the number: 7495, left him, and took on the next." The aircraft was flown by Second-Lt. H. A. Taylor.

The squadron remained in the line for the whole of the first war. In the middle of 1917 the Martinsydes were exchanged for D.H.4s and these, later, gave place to D.H.9s. Apart from its military prowess, No. 27 Squadron was also noted in the 1914-18 war for the development of high-level (14,500ft) photographic reconnaissance and all-weather flying.

At the end of hostilities No. 27 returned to England and was disbanded in January 1920; but the disbandment was not to last long, for the squadron was re-formed in India the next April.

Based on the Indus River, and now equipped with D.H.9a aircraft, the unit found itself mixed up with the tribal troubles of the N.W. Frontier; and in 1928, during the Afghan difficulties, its pilots made some of the earliest flights to Kabul to evacuate civilians from the European legations. In 1939, on the outbreak of war, it became a flying training unit at Risalpur.

When, in December 1941, the Japanese attacked in the Far East, No. 27 was flying Blenheims in Malaya as a night-fighter squadron. It was stationed at Sungei Patani, operating there with No. 21 Squadron. After a comparatively short spell of fighting, and when no Blenheims remained, it was overrun by the enemy; but personnel who managed to escape returned by devious routes to India, where they once more re-formed the squadron. On Christmas Day, 1942, No. 27 returned to operations as a Beaufighter squadron.

Nearly the whole of the remainder of the war was spent in fighting the Japanese. Hundreds of sorties were flown against road, rail and water transport, troops and enemy installations.

When the war was nearing its end the squadron was transferred to air/jungle rescue and supply-dropping duties. This was difficult work, in which dense jungle had to be searched for wrecked aircraft and supplies dropped to survivors. In February 1946 the unit was disbanded again.

The squadron was next heard of as a Transport Command squadron, having been re-formed yet again in England in 1947. This "life" was short even for No. 27. After doing some excellent work on the Berlin Airlift it was disbanded once more, in November 1950.

As befits a unit with such a splendid record, No. 27 was re-formed—in June 1953—to fly our newest and fastest jet bombers. It was then under the command of S/L. D. H. Chopping, D.F.C., who last year led six of the Canberras in a goodwill and training tour of the Mediterranean countries.

The C.O. is S/L. P. W. Helmore, D.F.C., A.F.C., son of A. Cdre. W. Helmore, who will be remembered for his war-time air commentaries. S/L. Helmore was a "Pathfinder" with No. 105 Squadron and has no fewer than 102 operational sorties against targets in Germany and Europe to his credit. By co-incidence it was he who put down the target indicators on D-Day for the Bostons in which his father was flying to get a first-hand view of the invasion.

With its present equipment the squadron's motto, "*Quam Celerrime ad Astra*" ("With all speed to the stars") is very apt.

J.Y.

Westland Wapitis of No. 27 Squadron at Kohat, N.W. Frontier, India, where the unit was stationed in the early 1930s.

One of the squadron's Bristol Beaufighters engaged on air/jungle rescue duties in Batavia during the last war.

Interested group at a recent cocktail party held at Londonderry House by Lansing Bagnall, Ltd. (left to right): Air Commodore H. Ford, Director of Armament Research and Development (Air), M.o.S.; R. H. Gluyas of Lansing Bagnall, Ltd.; Mrs. Ford; John R. Sharp, Lansing Bagnall managing director. In the background—Stubbs' life-size painting (circa 1800) of the race-horse Hambletonian.

THE INDUSTRY

Sleeve-valve Ignition Efficiency

IN conjunction with the Bristol Aeroplane Co., Ltd., the firm of K.L.G. Sparking Plugs, Ltd., have designed a new plug for use on Bristol sleeve-valve engines. An "overhead" earth wire replaces the more orthodox arrangement of "side-fire" earth wires used in plugs having precious-metal electrodes. This arrangement, it is stated, has shown in service that it gives longer life and longer periods between scheduled overhauls.

One of the principal reasons why side wires have been favoured for piston engines in the past is that the spark is not screened by the earth wire, so that the ignition of the mixture is normally more effective. By experiment, K.L.G. have found that if the body of the plug at the combustion-chamber end is given a bell-mouth form, the utmost use can be made of the excellent swirl characteristics in the cylinder of the sleeve-valve engine. This results in an induced circulation of the mixture within the plug mouth and makes the overhead gap fully effective by removing any screening effect which would otherwise be likely.

The use of unequal electrode dimensions has also increased gap stability while providing a partial "side-fire" effect. In this arrangement the diameter of the central electrode is larger than that of the earth wire.

The new plugs are now undergoing service trials in Centaurus 661 engines installed in B.E.A. Elizabethans and in Centaurus 173s in the Blackburn and General Aircraft Beverley.

Smiths Aircraft Instruments, Ltd., are the sole sales concessionaires for K.L.G. plugs.

Preventing Backlash in Gearing

THE problem of overcoming backlash in spur gearing is one that frequently arises in the design of small mechanical assemblies. In some cases, i.e., servo-mechanisms and indicating apparatus, the effect of backlash may be a critical factor.

A conventional method of overcoming the problem is to employ a coiled tension spring to pre-load one of the gear wheels torsionally. This method is not an ideal one, and in experiments to improve upon it the G.E.C. Research Laboratories have evolved a neat device which makes use of a standard circlip. This circlip is accommodated between two thin spur gears carried on a shouldered bush, one gear being fixed and the other free to revolve, and a pin in the face of each wheel registers with a clearance hole in the other wheel. On meshing of both wheels with the mating gear the free wheel is tensioned by an angular displacement of one tooth.

The G.E.C. Laboratories have successfully used the device—which is not subject to patent—over a range of wheels from 1in to 3in diameter and have introduced various detail refinements.

Fairey Apprentices' Examination Successes

FORTY-THREE members of the apprentice training scheme in the Fairey Aviation Company's group of factories were recently presented with cash prizes in recognition of examination successes during the past year. The presentation was made, at Hayes, by Mr. G. W. Hall (director, engineering).

Two apprentices who obtained Final Certificates in the City and Guilds machine-shop engineering course, and 17 who earned Higher National Certificates, each received a cheque for £10. The others were given £5 awards to mark success in the electrical and mechanical engineering sections of the Ordinary National Certificate examination, and the City and Guilds intermediate machine-shop engineering and sheet-metal-work courses.

In addition to obtaining his Higher National Certificate, D. P. McQuire received the special prize of £5 donated by the Company to Southall Technical College. The citation from Middlesex County Council stated that McQuire was "their most outstanding student." An ex-apprentice, P. J. Bashford, was admitted during 1954 on a County Scholarship to the College of Aeronautics.

At present 270 apprentices are under training in the Hayes group of factories and 141 in the Stockport group. Most of the Hayes apprentices complete theoretical studies at Southall Technical College. Northern factories attend Stockport Technical College. The Hayes apprentices have their own library, for the upkeep of which the directors make an annual grant.

"Know-how" in Packaging

THE directors of the 20th Century Joinery and Packing Co., Ltd., of Thames Ditton, Surrey, a firm which specializes in packaging for the aircraft industry, have announced plans involving capital investment of £100,000 in new plant and other projects. Among the latter is development of the company's training centre, plans for which were mentioned in *Flight* last year.

The firm feels that the growing importance of correct packaging of aircraft and guided missile components, for transport and storage in all climates, has made it essential to provide proper technical training for those who do the work. For this reason, all operatives will receive a thorough basic training at the new centre, followed by refresher courses to keep them informed of new developments.

Training methods will include workshop practice, film demonstrations, lectures and visits to aircraft factories. The centre will also include facilities for testing completed packages to the requirements of the Ministry of Supply.

IN BRIEF

Aerofilms, Ltd., have moved to new London offices at 4 Albemarle Street, W.1. The telephone number, Hyde Park 5211, remains unchanged.

* * *

Jenolite, Ltd., anti-corrosion and metal pre-treatment specialists, announce the appointment of Mr. L. F. Parsons as a new technical sales representative, based in the London area.

* * *

Among articles in the current issue (No. 30) of *Wiggin Nickel Alloys* is one on "Cutting fluids for machining Nimonic Alloys." The periodical is published by Henry Wiggin and Co. Ltd., of Wiggin Street, Birmingham, 16.

* * *

Rolls-Royce, Ltd., have recently produced a new edition of their excellent conversion tables (principally British, metric and American), in 100-page, handsomely bound pocket-book form. A limited number are available for executives in the industry in response to official applications.

Mr. J. A. Groce has joined Folland Aircraft, Ltd., as commercial manager. He was previously with de Havilland Aircraft, whom he joined in 1935, becoming their contracts manager five years later.

The Vacuum Oil Co., Ltd., tell *The Story of Coryton* in a non-technical documentary film describing the construction and opening of their big new refinery on the Essex bank of the Thames. Copies of the film (16 mm sound, monochrome, 30 minutes) will shortly be available on request from the Film Library, Sound Services, Ltd., 269 Kingston Road, Merton Park, London, S.W.19.

* * *

Painton and Co., Ltd., of Kingsthorpe, Northampton, publish a leaflet giving technical data on their new multi-contact "winkler" switch. A great variety is obtainable, in one-, two-, three-, and four-pole types, each of which is available mounted in one to six banks, and may be of either "make before break" or "break before make" types. The number of contacts ranges from three to 29.

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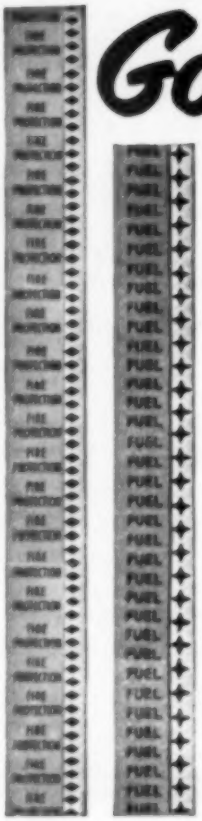

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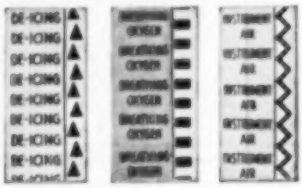

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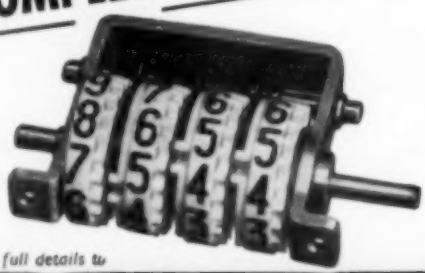

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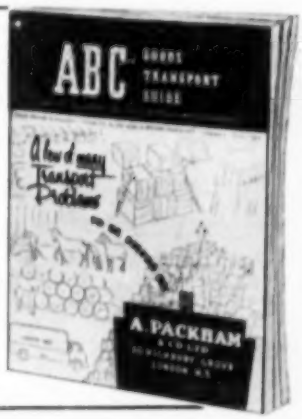

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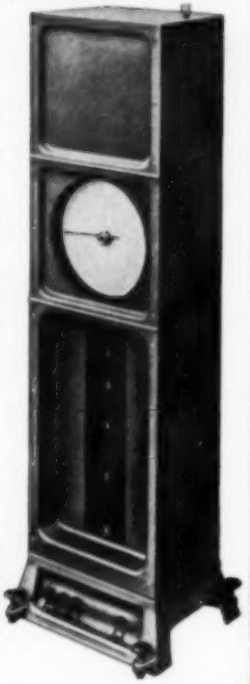

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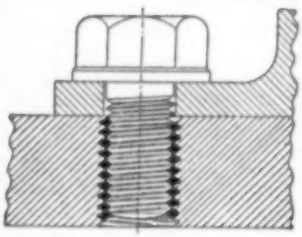
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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 447. From Eagle Aviation, Ltd., of 29 Clarges Street, London, W.1, for a normal scheduled service with Dakota and Viking aircraft for the carriage of passengers, supplementary freight and mail between London (Blackbushe) and Venice (San Nicolo/Treviso) at a frequency of from one to seven services weekly during the period from May 1st, 1955, to April 30th, 1965.

FROM Dragon Airways, Ltd., of Speke Airport, Liverpool, 19:—

APPLICATION No. 448. For a U.K. internal service with D.H.89A and D.H. Heron aircraft for the carriage of passengers, supplementary freight and mail between Stoke-on-Trent and Guernsey/Jersey at a frequency of from five to 10 services from April to October inclusive and from two to three services from November to March inclusive each year during the period from April 8th, 1955, to April 7th, 1962.

APPLICATION No. 449. For a seasonal U.K. internal service with D.H.89A and D.H. Heron aircraft for the carriage of passengers, supplementary freight and mail between Stoke-on-Trent and the Isle of Man (Ronaldsway) at a frequency of from five to 10 services weekly during the season from April to October inclusive each year, for a period of seven years commencing April 8th, 1955.

APPLICATION No. 450. From Air Kruise (Kent), Ltd., of Lympne Airport, Kent. For a seasonal inclusive tour service in conjunction with Transglobe, Ltd. (Birmingham), for the carriage of passengers between Birmingham (Elmdon) and Basle at a frequency of from one to two services weekly during the season from April to October inclusive each year for a period of seven years, commencing April 1st, 1955.

APPLICATION No. 38/1. From B.K.S. Air Transport, Ltd., of 1 Marylebone High Street, London, W.1, for the inclusion of Leeds (Yeadon) as a terminal and optional transit traffic stop at the discretion of the company on the seasonal inclusive tour service on the route Newcastle, West Hartlepool-Basle which they are approved by the Minister of Transport and Civil Aviation to operate in conjunction with Roberts' Tours, Ltd., until April 30th, 1960.

THE applications will be considered by the Council under the terms of reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within fourteen days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

THE Air Transport Advisory Council also give notice that the following application has now been withdrawn:—

APPLICATION No. 442. From British European Airways Corporation, of Keyline House, Ruislip, Middlesex, for a normal scheduled service between London Airport and Vienna with an optional intermediate traffic stop at Munich, with Viscount and Elizabethan aircraft, which was advertised in "The Times," "The Aeroplane" and "Flight" on December 31st, 1954. [3168

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(c) **Intermediate and Senior Technical Engineers** for the Structures Analysis and Aeroelasticity Sections. A degree or Higher National Certificate in Aeronautical, Mechanical or Structural Engineering is required.
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PUBLIC APPOINTMENTS

COMMONWEALTH OF AUSTRALIA

Department of Supply

Defence Standards Laboratories

Maribyrnong, Victoria

APPLICATIONS are invited for a temporary position of principal scientific officer at the above Laboratories.

SALARY £1,688/1,874 per annum.

DUTIES. To direct research and development in physical optics and optical instrument technology.

QUALIFICATIONS. University degree of high standard in physics, together with extensive relevant research experience; and proved capacity to initiate and conduct research in these fields.

THE salaries quoted are Australian currency.

WHILST the position is a temporary one, the tenure of employment is not limited. However, the successful applicant may choose to enter into an agreement for a three to five year contract of employment in Australia. In this case, the Commonwealth will bear return fare, together with cost of removing each way the appointee's furniture and effects up to a maximum cost of £500 (Australian).

UNDER specified conditions, first class boat fare (if first class berth available) for the appointee and dependants (wife and dependent children) will be paid by the Commonwealth.

APPLICATION forms obtainable from

SENIOR REPRESENTATIVE (AP.26),
Department of Supply,
Australia House,
Strand,
London, W.C.2.

With whom applications should be lodged by February 5th, 1955. [3176

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PUBLIC APPOINTMENTS

COMMONWEALTH OF AUSTRALIA

Department of Supply

Aeronautical Research Laboratories

Fishermen's Bend, Victoria

APPLICATIONS are invited for a temporary position of senior experimental officer, at the above laboratories.

SALARY. £1,352/1,442 p.a.

DUTIES. Responsible for initiating, planning and conducting experimental projects related to the strength of aircraft materials and components, and for developing and improving experimental methods and equipment.

QUALIFICATIONS. A degree or diploma in engineering or science, or equivalent, with passes Pure and Applied Mathematics I, Physics I, Metallurgy I and Strength of Materials.

A SOUND knowledge of theoretical stress analysis and several years' experience in an engineering laboratory essential. Engineering drawing and design experience an advantage.

THE salaries are Australian currency.

WHILST the position is a temporary one, the tenure of employment is not limited.

Under specified conditions, first-class boat fare (if first-class berth available) for the appointee and dependants (wife and dependent children) will be paid by the Commonwealth.

APPLICATION forms obtainable from

SENIOR REPRESENTATIVE (AP.25),
Department of Supply,
Australia House,
Strand,
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With whom applications should be lodged by February 5th, 1955. [3165

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Department of Supply

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THE salaries quoted are Australian currency.

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APPLICATION forms obtainable from

SENIOR REPRESENTATIVE (AP.24),
Department of Supply,
Australia House,
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London, W.C.2.

With whom applications should be lodged by February 5th, 1955. [3166

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Personnel Officer, ref: F/20, Saunders-Roe Limited, East Cowes, Isle of Wight

(Interviews will be arranged in London at weekends)

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ENGLISH ELECTRIC CO.'s

Guided Weapons Division at Luton, has created further vacancies for all grades of senior and junior staff for the

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with experience of production engineering of prototype electronic equipment coupled with a working knowledge of electronic circuitry.

Senior Engineer

to lead a large group of engineers and junior engineers in the development of specialised electronic test gear for factory and field use.

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with sound fundamental knowledge of electronics coupled with an ability to apply it to general circuit development.

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to lead a small group concerned with the development and field trials of ground radar equipment. Applicants should have had considerable previous experience of similar work.

Senior Engineer

for radar experiments and maintenance. Applicants should have a wide experience of Services radar equipments.

Senior Engineer

for missile telemetry installation planning. Applicants must be familiar with existing telemetry systems and measuring techniques. Although no trials work is involved this post would suit a man with trials experience.

Junior Engineers and Laboratory Assistants

are also required to assist in the above work.

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All of the above posts are permanent and progressive and attractive salaries are offered to the successful applicants. A staff pension scheme is in operation. Applications to: Dept. C.P.S., 336/7, Strand, W.C.2, ref. S.A.38D. [3144

SITUATIONS VACANT

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of

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HAS entered into a new field of activity in constructional engineering. The scope covers design, development and production of orthodox and prefabricated forms of constructions, including building elements and a wide range of interesting projects.

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(2) Junior draughtsmen improvers of Ordinary National Certificate standard with steelwork detailing experience.
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(5) Senior draughtsmen of Higher National Certificate standard experienced in light alloy design.

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Applicants should apply to The Chief Engineer, Bristol Aeroplane Company, Limited, Buildings Division, Banwell, Somerset, giving full particulars of experience, qualifications and present salary. [3162

AIRCRAFT DRAUGHTSMEN AND STRESSMEN

required.
Variety of interesting work.
37½ hour week.
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Middx. [3145

STARWAYS require captains with Dakota experience. ALTP or Senior Commercial licence with instrument rating.—Apply: Starways, Limited, Liverpool Airport, Liverpool, 19. [3146

SITUATIONS VACANT

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ARMSTRONG SIDDELEY has vacancies for:—
(1) Technical assistants in the departments of vibration, structural testing, balancing and engine test recording.
(2) Two engineers for electronic section.
(3) Design draughtsmen for design work.
(4) Instrument work on strain gauges. Dexterity with fingers essential.

APPLICANTS should have at least a higher National Certificate in Mechanical Engineering for (1) and Electrical Engineering for (2). Salary and prospects good.—Apply to Reference CG/ME5, Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [3135

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AN immediate requirement exists for holders of first-class licence for service at two Middle East locations. Two- and five-year appointments with regular home leave and good prospect of early availability of family accommodation.—Apply Airwork Limited, Overseas Division, Sutton Lane, Langley, Bucks. [3125

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SITUATIONS VACANT

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IN addition to technical liaison with customers and operators.

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INSPECTORS required by Skyways, Ltd., at Bovingdon and Stansted Airports. Experienced on Hermes and York aircraft, preferably with "A" or "C" licences.—Apply Personnel Manager, Skyways, Ltd., 7 Berkeley Street, London, W.1. [3151

TECHNICAL Author required by Hunting Percival Aircraft, Limited, for compilation of aircraft handbooks. Previous experience desirable and applications from ex-R.A.F. personnel with appropriate qualifications will receive special consideration. Good welfare facilities including staff pension scheme.—Applications in writing to Personnel Manager, Luton Airport, Beds., stating age, experience and salary required. [3124

FLIGHT REFUELLING LIMITED

have vacancies for

SENIOR and INTERMEDIATE DESIGN DRAUGHTSMEN with experience on mechanical and precision engineering for development work.

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SITUATIONS VACANT

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OPERATOR invites applications from flight engineers and flight radio officers to fill immediate vacancies. Recent experience multis essential. Vacancy also exists for staff navigation officer, Blackbushe based.—Box 1172. [3154

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THE DE HAVILLAND AIRCRAFT CO., LTD., Airspeed Division, Christchurch, Hants, require additional design draughtsmen (structural, mechanical and electrical) and loftsmen. See press reports of new design and development work.—Applications to: The Chief Draughtsman. [3150

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LARGE aero-engine manufacturer engaged in quantity production on gas turbine engines and now undertaking major sub-contracting activities invites applications from production engineers to co-ordinate activities of major sub-contractors. There are excellent opportunities within the company for advancement.

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ROCKET Division.—Armstrong Siddeley Motors require designers and draughtsmen for exacting work in this division. Applicants must possess HNC and/or have considerable drawing office experience.—Apply, quoting Reference CG/RD5, Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [3133

ESTIMATOR/Rate Fixer required for experimental and development establishment Berkshire area. Previous estimating experience essential backed by sound workshop training in light machine shop, sheet metal and electrical work. Good conditions and superannuation scheme.—Apply giving details of age, qualifications and experience to Box 1171. [3153

ARMSTRONG SIDDELEY MOTORS has vacancies for technical assistants in their main engine development department. The work deals with the development of all types of the company's aero engines from their earliest inception. Higher National Certificate in Mechanical Engineering essential. Prospects and salary good in this expanding department.—Apply, quoting Reference CG/X1, Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [3134

TECHNICAL author required for publications department to prepare descriptive, overhaul and servicing manuals on fuel components for gas turbine aero engines. Applicants must be of Higher National Certificate standard, with sound practical engineering experience, and have the ability to write clearly in concise terms. Applications should be sent to the Personnel Manager, Joseph Lucas (Gas Turbine Equipment), Ltd., Shaftmoor Lane, Hall Green, Birmingham, 28. [3172

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SITUATIONS VACANT

CERTIFIED engineer required for partnership in the north of England. Sale, maintenance, conversion and Cs. of A. for Geminis, Proctors, Rapides, etc. Capital and workshop available. Small capital required.—Box 0823. [3075

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APPLICATIONS are invited for a vacancy that has arisen with large aero-engine manufacturer in South-west England to co-ordinate and progress activities of a growing department responsible for major subcontracting. Candidates should have considerable experience of office routine and supervision in a production control or similar department with strong technical background and preferably experience in the aero-engine or allied industries. Write, giving details of age, education, industrial experience, together with details of salary required to the Personnel Manager, Box 1210. [3164

ARMSTRONG SIDDELEY MOTORS require senior draughtsmen for the design of special handling equipment for the manufacture of gas turbine engines and rocket motors. Position carries close liaison with the Services and airframe manufacturers. Applicants should be able to direct and co-ordinate the work of others. Junior draughtsmen are also required for detail work on the above. The company is expanding and the initial salary is good and prospects for the right men are excellent.—Apply to Reference CG/SD2, Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [3136

DEPUTY chief inspector. Applications are invited from engineers with some years' experience in a similar capacity. Applicants must have had experience of A.I.D. and War Office procedure and be suitably approved. The production is precision components in large quantities and successful applicant will be required to organize the final view room and line inspectors to maintain regular output. Inspectors personnel total approximately 180 day and night shift. The factory is new with canteen and recreational facilities, and forms part of an old-established Midlands Group. Replies in confidence to Box 1213. [3171

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Personnel Manager, Messrs. Rotol/British Messier, Ltd., Cheltenham Road, Gloucester.

SITUATIONS VACANT

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AIRCRAFT Instrument Engineers required by Skyways, Ltd., at Bovingdon Airport, Herts. Applicants must possess "X" licence. Applications giving full details of experience and qualifications to Administrative Superintendent, Skyways, Ltd., Bovingdon Airport, near Hemel Hempstead. [3157

WIRELESS operator required with first class P.M.G. licence preferably with experience on test-flying duties for a position at Nottingham. The successful applicant will form part of the aircrew who are carrying out test flights on civil and military aircraft. Applicants should also have experience on American equipment as fitted to Dakota military aircraft. Apply to Personnel Manager, Field Aircraft Services, Ltd., Croydon Airport. [3170

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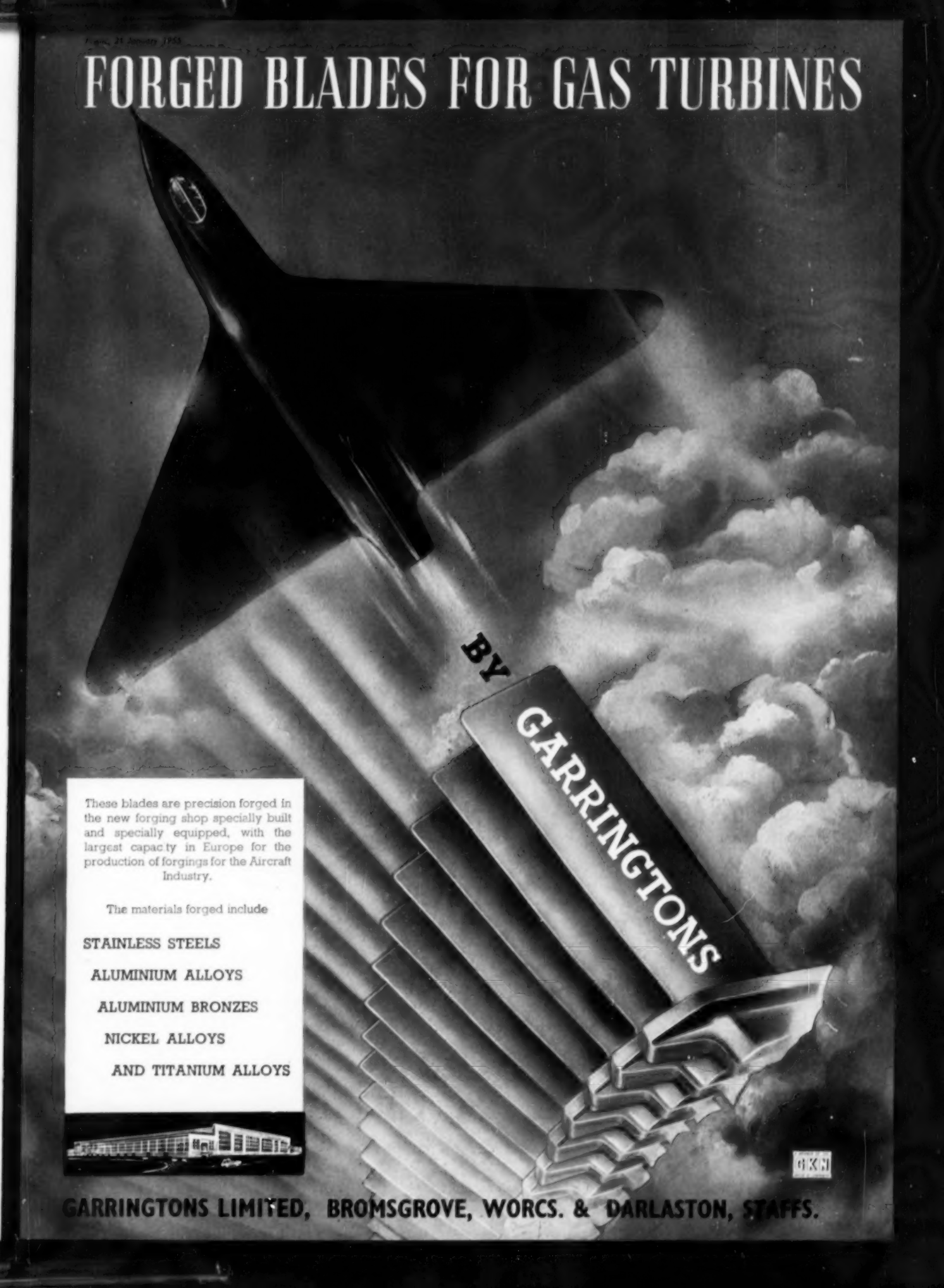

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Modern intercontinental airliners with their spares cost about a million pounds each, or roughly twice the price of the last generation of airliners. Their capital cost is usually depreciated over about six years, although their useful life is at least twice and nearer three times this period. The higher annual depreciation costs incurred would increase rather than lower the present operating cost unless the aircraft were capable of greatly increased work capacity. Each of the turboprop Britannias that Bristol is building can offer a yearly work capacity of about 11.5 million ton-miles —assuming each does 3,000 hours' flying a year at an average net speed (take-off to touch down) of 320 mph and carries 12 tons on each flight. In terms of passenger carriage—the measure being 10 passengers to the ton—this is equivalent to 115-million passenger-miles. In 1953 Pan-American Airways made available 3,200-million passenger-miles, which corresponds to the potential annual output of 27 Britannias, compared with that airline's fleet of 105 main line aircraft in service last year. In practice, of course, paper plans and estimates do not work out so ideally as this, and a greater margin of fleet capacity is required. But the arithmetic serves to show how the advanced capabilities of these new aircraft will enable lower costs to shippers and the travelling public to be achieved.

This enhanced work capacity, therefore, is the product of three factors: more speed due to greater power longer range due to fuel economy combined with speed, and many more seats. To offer one of these without the other two is not enough. For instance, an annual average speed of 400 mph allied to a capacity of 5 tons, makes possible at the same 3,000 hours' yearly utilisation, a work capacity of only 6-million ton-miles per aircraft by contrast with the Britannia's 320 mph, 12-ton capacity and 11.5 million ton-miles a year. And if the range of new aircraft is limited because of high fuel consumption, the annual average speed is reduced by the need for more fuelling stops—to say nothing of the higher fuel bills. Moreover, as payload is always subject to the weight of fuel that must be carried for a given distance, very high speeds at high consumption can be less rewarding than somewhat lower speed combined with more miles per gallon.

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